PATENT COOPERATION TREATY

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

CHOI, Kyu-Pal
824-11, Yeoksam-dong
Kangnam-ku
Seoul 135-080
RÉPUBLIQUE DE CORÉE

Date of mailing (day/month/year)
14 September 2001 (14.09.01)

Applicant's or agent's file reference
PC00017-LG

IMPORTANT NOTIFICATION

International application No.
PCT/KR00/01138

International filing date (day/month/year)
12 October 2000 (12.10.00)

1. The following indications appeared on record concerning:

[X] the applicant [ ] the inventor [ ] the agent [ ] the common representative

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2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[ ] the person [X] the name [ ] the address [ ] the nationality [ ] the residence

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3. Further observations, if necessary:

4. A copy of this notification has been sent to:

[X] the receiving Office
[X] the International Searching Authority
[ ] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[ ] the elected Offices concerned
[ ] other:

The International Bureau of WIPO
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004286690

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	**FOR FURTHER ACTION**	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
PC00017-LG		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/KR00/01138	12 OCTOBER 2000 (12.10.2000)	
Applicant		
LG CHEMICAL LTD. et al		

This International search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**
   a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
      ☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).
   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing:
      ☐ contained in the international application in written form.
      ☐ filed together with the international application in computer readable form.
      ☐ furnished subsequently to this Authority in written form.
      ☐ furnished subsequently to this Authority in computer readable form.
      ☐ the statement that the subsequenlty furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
      ☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.
2. ☐ **Certain claims were found unsearchable** (See Box I).
3. ☐ **Unity of invention is lacking** (See Box II).
4. With regard to the **title,**
   ☒ the text is approved as submitted by the applicant.
   ☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**
   ☒ the text is approved as submitted by the applicant.
   ☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.
6. The figure of the **drawing** to be published with the abstract is Figure No. _____
   ☐ as suggested by the applicant.
   ☐ because the applicant failed to suggest a figure.
   ☐ because this figure better characterizes the invention.
   ☒ None of the figures.

INTERNATION. . SEARCH REPORT

International application No.
PCT/KR00/01138

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 C07D 401/12, C07D 213/26, A01N 43/40

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimun documentation searched (classification system followed by classification symbols)

IPC 7 C07D

Documentation searched other than minimun documentation to the extent that such documents are included in the fileds searched

Korean patents and applications for inventions since 1975

Electronic data base consulted during the intertnational search (name of data base and, where practicable, search trerms used)

CAS ON LINE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 92/14728 A (Korea Research Institute of Chemical Technology) 03 Sep. 1992. See the whole document	1-12
A	WO 96/12708 A (Korea Research Institute of Chemical Technology) 2 May 1996 See the whole document	1-12

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevence

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevence; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevence; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
05 JULY 2001 (05.07.2001)	10 JULY 2001 (10.07.2001)

Name and mailing address of the ISA/KR	Authorized officer
Korean Intellectual Property Office Government Complex-Daejeon, Dunsan-dong, Seo-gu, Daejeon Metropolitan City 302-701, Republic of Korea Facsimile No. 82-42-472-7140	CHO, Myung Sun Telephone No. 82-42-481-5605

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

Information on patent family members

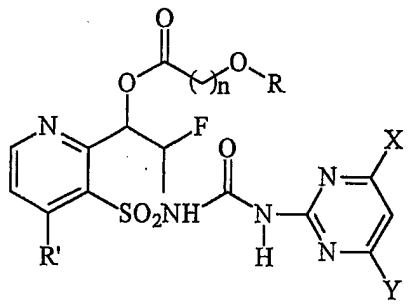
International application No.
PCT/KR00/01138

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 92/14728	03.09.1992	EP 639190 A	22.02.1995
		JP 2674878 B	12.11.1997
		KR 9309507 B	06.10.1993
		US 5461026 A	24.10.1995
WO 96/12708	02.05.1996	EP 788486 A	13.08.1997
		EP 788486 B	12.07.2000

HERBICIDALLY ACTIVE PYRIDINE SULFONYL UREA DERIVATIVES

TECHNICAL FIELD

The present invention relates to pyridine sulfonyl urea derivatives represented by the following formula (1):



(1)

in which

n denotes an integer of from 1 to 3,

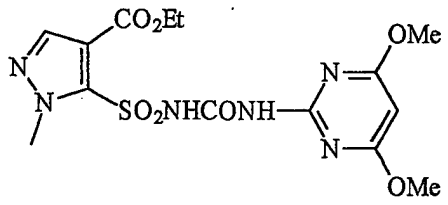
R represents H or C_1-C_4-alkyl,

R' represents H, C_1-C_4-alkyl, C_1-C_3-haloalkyl, halogen, or C_1-C_2-alkoxy, and

X and Y independently of one another represent C_1-C_2-alkyl, C_1-C_2-alkoxy, C_1-C_2-haloalkoxy, or halogen, salts or stereochemical isomers thereof showing an effective herbicidal activity in pre- and/or post-emergence treatment in rice farming, or to a method to use thereof, a method for the preparation thereof, an intermediate used for the preparation thereof, and a herbicidal composition comprising same.

BACKGROUND ART

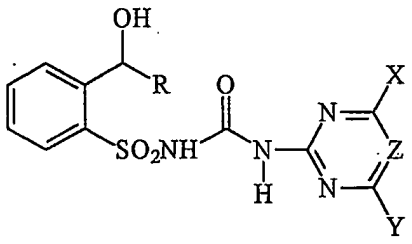
Hitherto, there have been reported a lot of sulfonyl urea derivatives having a herbicidal activity in rice farming. . For example, JP 61/191602 discloses a compound represented by the following formula (2):



(2) .

, which has been commercialized as a herbicide for rice farming in the name of Pyrazosulfuron-ethyl.

Korean Patent No. 70675 discloses a compound represented by the following formula (3):



(3) .

in which

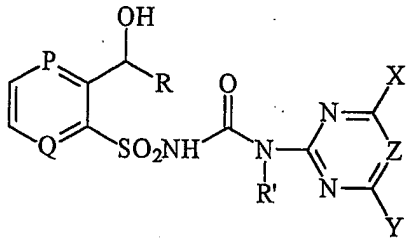
R represents haloalkyl,

X and Y independently of one another represent CH_3, OCH_3, Cl, etc., and

Z represents CH or N.

Korean Patent Application No. 91-3014 discloses a herbicidally active sulfonyl

urea derivative represented by the following formula (4):



(4)

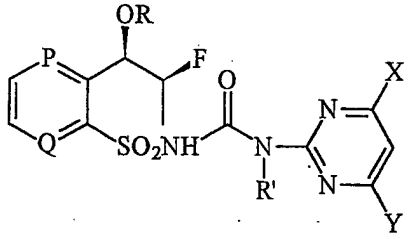
in which

R, X, Y and Z are defined as the above formula (3),

R' represents H or CH_3, and

P and Q independently of one another represent CH or N, but where the aromatic ring including P and Q is benzene or pyridine.

Korean Patent Application No. 93-6915 discloses a herbicidally active pyridine sulfonyl urea derivative represented by the following formula (5):



(5)

in which

P, Q, R', X and Y are defined as in the above formula (4),

R represents H, R^a-(C=O)- or R^a-X^a-(C=O)-, wherein R^a represents C_1~C_4-alkyl, C_1~C_3-haloalkyl, C_2~C_4-alkenyl or C_2~C_4-alkynyl, and X^a represents O, S, NH or NR^a.

The existing sulfonyl urea-based herbicidal compounds as explained above show an excellent herbicidal activity against annual and perennial weeds in rice, but have weak

activity to barnyardgrass which is the most problematic weed in rice, or cause some phytotoxicity to rice plant. The present inventors claim new pyridine sulfonyl urea derivatives having improved rice safety and superior herbicidal activity against barnyardgrass to the earlier herbicidal compounds, and find great advantages of these new compounds when used as a rice herbicide.

Therefore, one object of the present invention is to provide the pyridine sulfonyl urea derivatives of the above formula (1), salts or stereochemical isomers thereof.

It is another object of the present invention to provide a process for the preparation of the compound of formula (1).

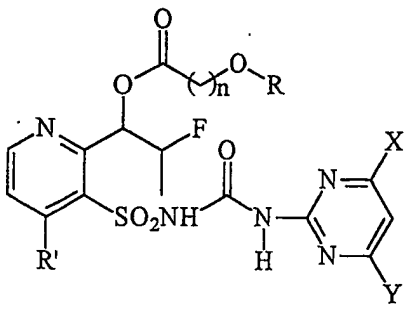
It is further object of the present invention to provide a novel intermediate which is used for the preparation of the compound of formula (1).

It is further object of the present invention to provide a method to use the compound of formula (1) as a herbicide for paddy rice, and a herbicidal composition comprising same.

The present invention will be explained in more detail hereinafter.

DISCLOSURE OF INVENTION

The present invention relates to a compound of the following formula (1):



(1)

in which

n denotes an integer of from 1 to 3,

R represents H or C_1-C_4-alkyl,

R' represents H, C_1-C_4-alkyl, C_1-C_3-haloalkyl, halogen, or C_1-C_2-alkoxy, and

X and Y independently of one another represent C_1-C_2-alkyl, C_1-C_2-alkoxy, C_1-C_2-haloalkoxy, or halogen.

Among the compound of formula (1) which shows an excellent selectivity to rice plant and herbicidal activity to barnyardgrass and thus, can be advantageously used as a herbicide for rice farming, the preferred compounds include those wherein n denotes an integer of 1 or 2, R represents H or methyl, R' represents H, halogen or methyl, and X and Y each represents methoxy.

Particularly preferred compounds include those wherein n denotes an integer of 1 or 2, R represents methyl, R' represents H, Cl, Br or methyl, and X and Y each represents methoxy.

Typical examples of the compound of formula (1) according to the present invention are exemplified as follows:

N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-2-(2-fluoro-1-methoxy acetoxy-n-propyl)pyridine-3-sulfonamide.

N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-2-(2-fluoro-1-hydroxy acetoxy-n-propyl)pyridine-3-sulfonamide.

N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-2-(2-fluoro-1-(3-hydroxy propion)oxy-n-propyl)pyridine-3-sulfonamide.

N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-2-(2-fluoro-1-(3-methoxypropion)oxy-n-propyl)pyridine-3-sulfonamide.

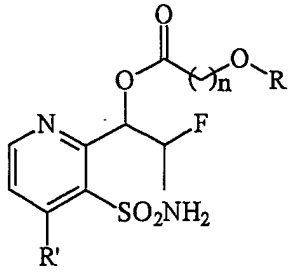
N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-4-methyl-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide.

N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-4-chloro-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide.

N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-4-bromo-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide.

Since the compound of formula (1) has two asymmetric carbons therein, they can exist as an erythro or threo isomer, or mixtures thereof. The compound of the present invention shows a stronger activity in the erythro form, but the mixtures thereof in a suitable mixing ratio also exhibit a sufficient activity.

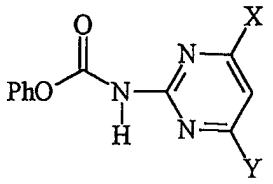
The compound of formula (1) according to the present invention can be prepared by a process characterized in that a compound represented by the following formula (6):



(6)

in which

n, R and R' are defined as in the above formula (1), is reacted in a solvent optionally in the presence of a base with a compound represented by the following formula (7):



(7)

in which

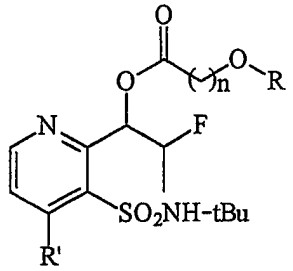
X and Y are defined as in the above formula (1). Therefore, it is another object of the present invention to provide such a preparation process.

The compound of formula (6) used as a starting material in the process according to the present invention can exist as an erythro isomer, threo isomer, or mixtures thereof. The stereo-chemical configuration of the desired compound of formula (1) may be determined in line with the configuration of compound (6).

Any solvent which does not adversely affect the reaction can be used in the above process, but preferably tetrahydrofuran, acetone, acetonitrile, dioxane, methylene chloride, toluene, butanol, pyridine, dimethylformamide, etc. can be used. The above process is carried out preferably in the presence of a small amount of strong base, such as for example, triethylamine, hexamethylenetetramine, pyridine, DBU or DABCO (wherein DBU means 1,8-diazabicyclo[5,4,0]undec-7-ene and DABCO means 1,4-diazabicyclo[2,2,2]octane, and they have the same meaning throughout the present specification), etc., and the reaction temperature may be preferably maintained in the range of 10～80℃. The specific reaction conditions can be referred to USP 4,443,245 which discusses similar reactions, and after the reaction is completed, the desired compound can be obtained through the acid-treatment procedure as described in EP 044,807. If a highly pure compound is required, it is desirable to use HPLC technique.

The compound of formula (7) was known and can be easily prepared according to the process described in Korean Patent No. 70,675.

The compound of formula (6) is a novel intermediate which is provided first by the present invention. Therefore, it is another subject matter to be provided by the present invention. The compound of formula (6) can be prepared by treating a compound represented by the following formula (8):

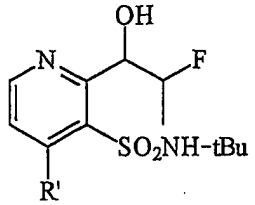


(8)

in which, n, R and R' are defined as formula (1), with trifluoroacetic acid (TFA) to eliminate the t-butyl group therefrom.

If the compound of formula (8) is stirred in the solvent of trifluoroacetic acid(TFA) at 0~80°C, the t-butyl group is eliminated to give the sulfonamide compound of formula (6). When the compound of formula (6) thus obtained is present in the form of an erythro-threo mixture, it may be resolved by column chromatography, HPLC or preparative-TLC method to give pure erythro or threo compound.

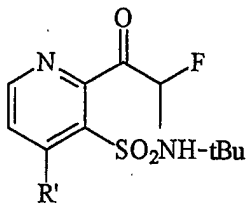
The compound of formula (8) may also be prepared by acylating a compound represented by the following formula (9) according to a conventional manner:



(9)

in which R' is defined as in the above formula (1).

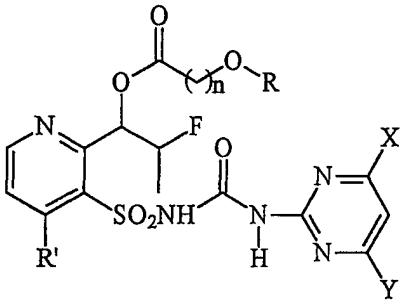
The compound of formula (9) may be prepared by selectively reducing a compound represented by the following formula (10):



(10)

in which R' is defined as in the above formula (1), using a suitable reducing agent, such as for example, DIBAL-H(Diisobutylaluminum hydride), $NaBH_4$, $LiAlH_4$, BH_3.

The compound of formula (1) as can be prepared as explained above is more definitely exemplified individually in the following Table 1.



[Table 1]

R'	n	R	X	Y	m.p.(°C)
Cl	1	CH_3	Ome	OMe	135-140
Br	1	CH_3	Ome	OMe	87-89
Br	1	H	Ome	OMe	
OCH_3	1	CH_3	Ome	OMe	
CH_3	1	CH_3	Ome	OMe	156-158
CF_3	1	CH_3	Ome	OMe	
H	1	H	Ome	OMe	157-158
CH_3	2	CH_3	Ome	OMe	
H	1	CH_3	Ome	OMe	175-177(erythro)
H	1	CH_3	Ome	OMe	152-154(threo)
H	1	CH_3	Ome	Cl	
H	1	CH_3	Me	Me	
H	2	H	Ome	OMe	147-148
H	2	CH_3	Ome	OMe	145-146

The compound of formula (1) according to the present invention may exist as a suitable salt and is utilizable as a herbicide in that form. The salt can be prepared by a conventional method known per se, for example, by contacting the compound of formula (1) with a solution containing hydroxide, alkoxide, or carbonate of alkali metal or alkaline earth metal. Otherwise, the salt may be prepared by using an amine compound in the similar manner.

Various salts can also be obtained by exchanging the cation of the salt of compound of formula (1) by another one. Cation exchange is carried out by directly contacting a salt of the compound of formula (1), for example, alkali metal salt or quarternary amine salt in aqueous solution with a solution containing the cation to be

newly combined. This method is the most effective when the resulting salt containing the newly combined cation is insoluble in water. Ion exchange can also be carried out by subjecting a salt of the compound of formula (1), for example, alkali metal salt or quarternary amine salt in aqueous solution to a column filled with cation exchange resin containing the cation to be newly combined. In this case, the cation in the resin is exchanged with the cation of the original salt and the desired salt newly formed is eluted from the column. This method is particularly effective when the resulting salt is water-soluble, that is, sodium, potassium or calcium salt.

Further, the compound of formula (1) is conveniently used as a herbicidal agent when it is present in the form of mixtures or complexes with urea or amide compound. Those mixtures or complexes may be prepared according to the typical methods.

The preparation or conversion process as briefly summarized above may be easily carried out by a person skilled in the area of organic synthesis or synthesis of sulfonyl urea derivatives. All the processes designed from the present description by conventional modifications fall within the scope of the present invention.

As stated already, the pyridine sulfonyl urea derivative of formula (1) according to the present invention can be used as a herbicidal agent. Therefore, the utilities and formulations are explained below.

[Utility]

Since the compound of formula (1) has an excellent selectivity for rice plant as well as a potent herbicidal activity, it can be used as a herbicide for paddy rice and can be contained as an active ingredient in herbicidal composition.

Test results indicate that the compound of formula (1) is highly active as a herbicide for pre- or post-emergence treatment in paddy and upland.

The rates of application of the active compound of the invention are determined by a number of factors, including the types of weeds to be controlled, weather, climate, formulations selected, mode of application, size of weeds, etc. In general terms, the subject compounds should be applied at levels of around 1g to 1 kg/ha, the lower rates being suggested for use on soils having a low organic matter content or sandy soil, for young plants, or for situations where only short-term persistence is required. Particularly, the subject compounds may be used effectively in rice to control various weeds including barnyardgrass, annual broadleaf and sedge weeds as well as perennial weeds.

The compounds of the present invention may be used alone or as two-, three-, or four-way combinations together with the existing herbicides.

[Formulation]

In the present invention, the compound of formula (1) is used in the form of a conventional composition. If necessary, the compound of formula (1) is applied to plant, soil, or water surface in combination with carriers, surfactants, adjuvants, or other additives which are conveniently used in the technical field of formulation.

Suitable carriers and additives may be a solid or a liquid and include those components effectively used in the field of formulation, such as for example, natural or synthetic inorganic substances, solvents, dispersants, wetting agents, adhesive agents, thickening agents, binding agents, etc.

The composition comprising the compound of formula (1) is preferably applied to soil in the form of a solid, for example, a granule, or liquid (soil treatment). Otherwise, the composition comprising the compound of formula (1) may be applied directly to a plant foliage (foliar treatment). Frequency and rate of application are varied depending

on the biological characteristics of plants, weather, soil types, and other environmental conditions.

The active ingredient-containing combinations in unmodified form can be used together with the known adjuvants conveniently used in the field of formulation. They are formulated according to the known methods to emulsifiable concentrates, liquid formulations which can be diluted, liquid hydrates which can be directly applied to water surface, developing agent for water surface, emulsions, hydrates, powders, dusts, granules or tablets. Application methods such as spraying, dusting, broadcasting, etc. and characteristics of the composition are selected to be compatible with the purpose of use and environments. The rate of application of the active ingredient-containing combination varies generally in the range of from 1g to 1kg a.i./ha, preferably from 10g to 30g a.i./ha.

For example, the active ingredient may be intimately mixed and/or pulverized with extenders[e.g. solvents, solid carriers and if desired, surface-active compounds (surfactants)] according to the known methods to give the combinations.

Possible solvents include the following: aromatic hydrocarbons such as xylene mixtures or substituted naphthalenes; alcohols and glycols, and their ethers and esters such as ethanol, ethylene glycol, ethylene glycol monomethyl or monoethyl ether; ketones such as cyclohexanone; strongly polar solvents such as N-methyl-2-pyrrolidone, dimethylsulfoxide or dimethylformamide; optionally epoxidised vegetable oils such as epoxidised coconut oil or soybean oil; and water. These solvents can be used as emulsifying agents, solvents for liquid formulation or cosolvents for granule formulation.

The solid carriers used e.g. for dusts and granules, are normally pulverized natural mineral fillers such as talc, kaolin, montmorillonite, pyrophyllite, bentonite, calcite, or adsorptive carriers such as zeolite, or sand. In addition, a great number of prepulverized materials of inorganic or organic nature can be used.

Depending on the nature of the compound of formula (1) to be formulated, suitable surface-active compounds are nonionic, cationic and/or anionic surfactants having good dispersing, wetting and lubricating properties. The term "surfactants" will also be understood as comprising mixtures of surfactants.

The herbicidal compositions, broadly, contain 0.1 to 99% by weight, preferably 0.1 to 95% by weight of the compound of formula (1), 99.9 to 1% by weight, preferably 99.9 to 5% by weight of solid or liquid additives, and 0 to 25% by weight, preferably 0.1 to 25% by weight of surfactant.

These compositions fall within the scope of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

The process for the preparation and use of the compound according to the present invention will be more specifically explained in the following Examples. However, it should be understood that these Examples are intended to illustrate the present invention but not in any manner to limit the scope of the present invention. Unless otherwise stated, C18 silica(25-40μm, 50mℓ) column equilibrated with acetonitrile/water=10/90(v/v) was used as the stationary phase of column chromatography in the following Examples.

Example 1: Synthesis of erythro-N-t-butyl-4-methyl-2-(2-fluoro-1-hydroxy-n-propyl)pyridine-3-sulfonamide

Erythro-N-t-butyl-2-(2-fluoro-1-hydroxy-n-propyl)pyridine-3-sulfonamide (2.55g) was dissolved in THF(150mℓ) which had been well purified and then 2.5N n-BuLi(13.4mℓ) was slowly added thereto under nitrogen gas at -78℃. The reaction temperature was raised to -20℃ and cooled down to -78℃ again. CuI(2.10g) was introduced into

another flask and the lithium salt prepared above was reversely added to this flask. After 10 minutes, CH_3I(0.83㎖) was added, the resulting mixture was stirred for 30 minutes at -78℃, and the reaction was quenched with NH_4Cl solution. Ethyl acetate was added to the reaction solution to separate the organic layer. The aqueous layer was extracted with ethyl acetate, and then the organic layers were combined, dried($MgSO_4$), filtered and concentrated to give a crude product. This crude product was subjected to column chromatography (Moving phase: ethyl acetate/n-hexane=1/2, v/v) to give 0.5g of the pure title compound.

^{1}H NMR(200MHz, $CDCl_3$) : δ 8.55(d, 1H, J=5Hz), 7.24(d, 1H, J=5Hz), 6.1 (br s, 1H), 4.6~4.9(m, 3H), 2.76(s, 3H), 1.35(dd, 3H, J_1=25Hz, J_2=6Hz), 1.26 (s, 9H)

Example 2: Synthesis of erythro-4-methyl-2-(2-fluoro-1-methoxy- acetoxy-n-propyl)pyridine-3-sulfonamide

Erythro-N-t-butyl-4-methyl-2-(2-fluoro-1-hydroxy-n-propyl)pyridine-3-sulfonamide(0.7g) was dissolved in THF(10㎖) and methoxyacetylchloride(0.32g) was added thereto. 60% NaH(0.13g) was added at 0℃ and the resulting mixture was stirred for 2 hours at room temperature. The reaction was quenched with saturated aqueous NH_4Cl solution and extracted with ethyl acetate. The organic layer was dried($MgSO_4$), filtered and concentrated, and the residue was subjected to column chromatography(Moving phase: ethyl acetate/n-hexane=1/3, v/v) to give erythro-N-t-butyl-4-methyl-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide(0.7g).

To the resulting product was added CF_3CO_2H(10㎖) and the mixture was stirred for 1 hour at 60~65℃. The reaction solution was concentrated under reduced pressure and the residue was dissolved in methylene chloride and washed with aqueous sodium bicarbonate solution. The organic layer was dried($MgSO_4$), filtered and concentrated, and the residue was subjected to column chromatography (Moving phase: ethyl acetate/methylene chloride=1/7→ 1/1, v/v) to give 0.37g of the pure title compound.

^{1}H NMR(200MHz, $CDCl_3$) : δ 8.57(d, 1H, J=5Hz), 7.24(d, 1H, J=5Hz), 6.85~6.95(m, 1H), 5.65(br s, 2H), 4.9~5.3(m, 1H), 4.13(s, 2H), 3.41(s, 2H), 2.72(s, 3H), 1.55(dd, 3H, J_1=25Hz, J_2=6Hz)

Example 3: Synthesis of erythro-N-t-butyl-4-chloro-2-(2-fluoro-1-hydroxy-n-propyl)pyridine-3-sulfonamide

Erythro-N-t-butyl-2-(2-fluoro-1-hydroxy-n-propyl)pyridine-3-sulfonamide(0.29g) was dissolved in THF(10㎖) which had been well purified and then 2.5N n-BuLi(1.52㎖) was slowly added thereto under nitrogen gas at -78℃. The reaction temperature was raised to -20℃ and cooled down to -78℃ again. NCS(N-chlorosuccinimide)(0.2g) dissolved in THF(5㎖) was slowly added to the reaction solution. After 30 minutes, the reaction was quenched with saturated aqueous ammonium chloride solution. Ethyl acetate was added to the reaction solution to separate the organic layer. The aqueous layer was extracted once more with ethyl acetate, and then the organic layers were combined, dried ($MgSO_4$), filtered and concentrated to give a crude product. This crude product was subjected to column chromatography (Moving phase: ethyl acetate/n-hexane=1/2, v/v) to give 0.18g of the pure title compound.

^{1}H NMR(200MHz, $CDCl_3$) : δ 8.61(d, 1H, J=5Hz), 7.50(d, 1H, J=5Hz), 6.05~6.15(br s, 1H), 5.2(br s, 1H), 4.6~4.9(m, 2H), 1.35(dd, 3H, J_1=25Hz, J_2=6Hz), 1.25(s, 9H)

Example 4: Synthesis of erythro-N-t-butyl-4-chloro-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide

Erythro-N-t-butyl-4-chloro-2-(2-fluoro-1-hydroxy-n-propyl)pyridine-3-sulfonamide(0.75g) was dissolved in THF(10㎖) and methoxyacetylchloride(0.33g) was added thereto. The reaction solution was cooled down to 0℃ and 60% NaH (0.13g) was added. The resulting solution was warmed to room temperature and stirred for 2 hours.

The reaction was quenched with aqueous ammonium chloride solution. The reaction solution was extracted with ethyl acetate and the organic layer was dried ($MgSO_4$), filtered and concentrated. The residue was subjected to column chromatography (Moving phase: ethyl acetate/n-hexane=1/3, v/v) to give 0.7g of the pure title compound.

^{1}H NMR(200MHz, $CDCl_3$) : δ 8.60(d, 1H, J=5Hz), 7.46(d, 1H, J=5Hz), 7.05~7.15(m, 1H), 5.45(br s, 1H), 4.9~5.3(m, 1H), 2.1(s, 3H), 1.44(dd, 3H, J_1 =25Hz, J_2=6Hz), 1.31(s, 9H)

Example 5: Synthesis of erythro-N-t-butyl-4-bromo-2-(2-fluoro-1-hydroxy-n-propyl)pyridine-3-sulfonamide

Erythro-N-t-butyl-2-(2-fluoro-1-hydroxy-n-propyl)pyridine-3-sulfonamide(7.0g) was dissolved in THF(200㎖) which had been well purified and then 2.5N n-BuLi (13.4㎖) was slowly added thereto under nitrogen gas at -78℃. The reaction temperature was raised to -20℃ and cooled down to -78℃ again. NBS(N-bromosuccinimide)(6.4g) was added to the reaction solution and the resulting mixture was stirred for 30minutes. The reaction was quenched with saturated aqueous ammonium chloride solution. Ethyl acetate was added to the reaction solution to separate the organic layer. The aqueous layer was extracted once more with ethyl acetate, and then the organic layers were combined, dried ($MgSO_4$), filtered and concentrated to give a crude product. This crude product was subjected to column chromatography (Moving phase: ethyl acetate/n-hexane=1/2, v/v) to give 3.9g of the pure title compound.

^{1}H NMR(200MHz, $CDCl_3$) : δ 8.48(d, 1H, J=5Hz), 7.74(d, 1H, J=5Hz), 6.5(br s, 1H), 5.39(br s, 1H), 4.6~4.95(m, 2H), 1.32(dd, 3H, J_1=25Hz, J_2=6Hz), 1.25(s, 9H)

Example 6: Synthesis of erythro-4-bromo-2-(2-fluoro-1-hydroxy-n-propyl) pyridine-3-sulfonamide

Erythro-N-t-butyl-4-bromo-2-(2-fluoro-1-hydroxy-n-propyl)pyridine-3-sulfonamide(0.5g) was dissolved in trifluoroacetic acid(CF_3CO_2H; 10㎖) and the resulting solution was stirred for 2 hours at 60～65℃. The reaction solution was concentrated under reduced pressure, and then the filtrate was diluted with methylene chloride and concentrated. The residue was subjected to column chromatography (Moving phase: ethyl acetate/methylene chloride=1/7→ 1/1, v/v) to give 0.3g of the pure title compound.

^{1}H NMR(200MHz, $CDCl_3$) : δ 8.49(d, 1H, J=5Hz), 7.75(d, 1H, J=5Hz), 6.0～6.06(m, 1H), 5.45(br s, 2H), 4.15～4.55(m, 1H), 3.46(br s, 1H), 1.53(dd, 3H, J_1 =25Hz, J_2=6Hz)

Example 7: Synthesis of erythro-N-[(4,6-dimethoxypyrimidin-2-yl)amino carbonyl]-4-chloro-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide

Erythro-4-chloro-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide (0.5g) was dissolved in acetonitrile(10㎖) and phenyl (4,6-dimethoxypyrimidin-2-yl)carbamate(0.86g) was added thereto at room temperature. DBU(0.48g) was slowly added and the reaction solution was stirred for 30minutes, diluted with methylene chloride(100㎖) and washed with 5% aqueous hydrochloric acid solution(50㎖). The organic layer was dried ($MgSO_4$), filtered and concentrated. The residue was recrystallized from diethylether/n-hexane to give 0.61g of the pure title compound as a white solid.

m.p. : 135～140℃

^{1}H NMR(200MHz, $CDCl_3$) : δ 13.2(br s, 1H), 8.63(d, 1H, J=5Hz), 7.45(d, 1H, J=5Hz), 7.2～7.4(m, 2H), 5.81(s, 1H), 4.82～5.22(m, 1H), 3.97(s, 6H), 1.44(dd, 3H, J_1=25Hz, J_2=6Hz)

Example 8: Synthesis of erythro-N-[(4,6-dimethoxypyrimidin-2-yl)amino carbonyl]-4-bromo-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide

Erythro-4-bromo-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide (0.82g) and phenyl (4,6-dimethoxypyrimidin-2-yl)carbamate(0.86g) were reacted according to the same procedure as Example 7 to give 0.85g of the title compound as a white solid.

m.p. : 87-89℃

^{1}H NMR(200MHz, $CDCl_3$) δ 8.49(d, 1H, J=5Hz), 7.65(d, 1H, J=5Hz), 7.23(s, 1H), 7.02-7.1(m, 1H), 5.80(s, 1H), 5.22-5.58(m, 1H), 4.13(s, 2H), 3.96(s, 6H), 3.41(s, 3H), 1.48(dd, 3H, J_1=25Hz, J_2=6Hz)

Example 9: Synthesis of erythro-N-[(4,6-dimethoxypyrimidin-2-yl)amino carbonyl]-4-methyl-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide

Erythro-4-methyl-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide (0.73g) and phenyl (4,6-dimethoxypyrimidin-2-yl)carbamate(0.86g) were reacted according to the same procedure as Example 7 to give 0.75g of the title compound as a white solid.

m.p. : 156-158℃

^{1}H NMR(200MHz, $CDCl_3$) δ 8.58(d, 1H, J=5Hz), 7.23(d, 1H, J=5Hz), 7.21 (br s, 1H), 6.65-6.75(m, 1H), 5.78(s, 1H), 5.05-5.38(m, 1H), 4.13(s, 2H), 3.97(s, 6H), 3.41(s, 3H), 2.89(s, 3H), 1.47(dd, 3H, J_1=25Hz, J_2=6Hz)

Example 10: Synthesis of erythro-2-(2-fluoro-1-methoxyacetoxy-n-propyl) pyridine-3-sulfonamide and threo-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide

1:1 mixture of erythro and threo isomers of N-t-butyl-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide(5.0g) was dissolved in trifluoroacetic

acid(20㎖). The reaction solution was stirred for 12 hours at 45℃ and concentrated under reduced pressure. The residue was dissolved in methylene chloride, which was then washed with aqueous sodium bicarbonate solution. The organic layer was dried over anhydrous magnesium sulfate and the residue was subjected to column chromatography (Moving phase: ethyl acetate/methylene chloride=1/7→ 1/1, v/v) to give 1.0g of the title compound in the pure erythro form and 1.0g of the title compound in the pure threo form, respectively, as a solid.

Erythro compound.

^{1}H NMR(200MHz, $CDCl_3$) : δ 8.82-8.85(m, 1H), 8.35-8.38(m, 1H), 7.43-7.50 (m, 1H), 6.60-6.72(m, 1H), 5.68(brs, 2H), 4.93-5.29(m, 1H), 4.18(s, 2H), 3.2(s, 3H), 1.55(dd, 3H, J_{H-H}=6.5Hz, J_{H-F}=25Hz),

Threo compound

^{1}H NMR(270MHz, $CDCl_3$) : δ 8.82-8.85(m, 1H), 8.35-8.38(m, 1H), 7.43-7.50 (m, 1H), 6.60-6.72(m, 1H), 5.58(brs, 2H), 5.29-5.40(m, 1H), 4.18(s, 2H), 3.43(s, 3H), 1.20(dd, 3H, J_{H-H}=6.5Hz, J_{H-F}=25Hz)

Example 11: Synthesis of erythro-2-(2-fluoro-1-hydroxyacetoxy-n-propyl) pyridine-3-sulfonamide

Erythro-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide(0.5g) was dissolved in chloroform(10㎖), iodotrimethylsilane(0.9㎖) was added thereto, and the resulting mixture was stirred for 12 hours at 60℃. The reaction solution was concentrated and the residue was subjected to C18 silica(50㎖) column chromatography (Moving phase: CH_3CN/H_2O=10/90, v/v) to give 0.22g of the title compound.

m.p. : 142-143℃

^{1}H NMR(200MHz, D_2O) : δ 8.82-8.85(m, 1H), 8.35-8.38(m, 1H), 7.43- 7.50(m, 1H), 5.0-5.4(m, 1H), 4.4(d, 2H), 1.55(dd, 3H)

Example 12: Synthesis of erythro-2-(2-fluoro-1-(3-methoxypropion)oxy-n-propyl)pyridine-3-sulfonamide

Erythro-N-t-butyl-2-(2-fluoro-1-(3-methoxypropion)oxy-n-propyl)pyridine-3-sulfonamide(5.0g) was reacted according to the same procedure as Example 10 to give 2.0g of the title compound.

^{1}H NMR(200MHz, $CDCl_3$) : δ 8.82-8.85(m, 1H), 8.35-8.38(m, 1H), 7.43-7.50 (m, 1H), 6.60-6.72(m, 1H), 5.75(brs, 2H), 4.93-5.29(m, 1H), 3.62(t, 2H), 3.3(s, 3H), 2.7(m, 2H), 1.55(dd, 3H)

Example 13: Synthesis of erythro-2-(2-fluoro-1-(3-hydroxypropion)oxy-n-propyl)pyridine-3-sulfonamide

Erythro-2-(2-fluoro-1-(3-methoxypropion)oxy-n-propyl)pyridine-3-sulfonamide (0.56g) was reacted according to the same procedure as Example 11 to give 0.12g of the title compound.

^{1}H NMR(200MHz, D_2O) : δ 8.8(m, 1H), 8.4(m, 1H), 7.45(m, 1H), 6.9(brs, 2H), 6.75(m, 1H), 5.0-5.3(m, 1H), 3.8(m, 2H), 2.6(t, 2H), 1.55(dd, 3H)

Example 14: Synthesis of erythro-N-[(4,6-dimethoxypyrimidin-2-yl)amino carbonyl]-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide

Erythro-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide(3.9g) was dissolved in acetonitrile(20㎖), phenyl (4,6-dimethoxypyrimidin-2-yl)carbamate (3.57g) was added, and then triethylamine(1.32g) was slowly added thereto. The reaction solution was stirred for 2 hours, diluted with methylene chloride(20㎖) and then washed with 5% aqueous hydrochloric acid solution(10㎖) and water(10㎖). The organic layer

was dried over magnesium sulfate, filtered and concentrated. The residue was recrystallized from ethyl acetate/hexane/diethylether to give 4.5g of the title compound.

m.p. : 175-177℃

^{1}H NMR(200MHz, $CDCl_3$) : δ 13.2(br, 1H), 8.8(m, 1H), 8.6(m, 1H), 7.5(m, 1H), 7.2(br, 1H), 6.6(m, 1H), 5.80(s, 1H), 5.0-5.3(m, 1H), 4.05(s, 2H), 3.96(s, 6H), 3.25(s, 3H), 1.45(dd, 3H)

Example 15: Synthesis of threo-N-[(4,6-dimethoxypyrimidin-2-yl)amino carbonyl]-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide

Threo-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide (1.56g) and phenyl (4,6-dimethoxypyrimidin-2-yl)carbamate(2.99g) were reacted according to the same procedure as Example 14 to give 1.8g of the title compound as a white solid.

m.p. : 152-154℃

^{1}H NMR(200MHz, $CDCl_3$) : δ 13.2(br, 1H), 8.81(m, 1H), 8.67(m, 1H), 7.50(m, 1H), 7.49(br, 1H), 6.67(m, 1H), 5.80(s, 1H), 5.0-5.3(m, 1H), 4.05 (s, 2H), 3.96(s, 6H), 3.25(s, 3H), 1.28(dd, 3H)

Example 16: Synthesis of erythro-N-[(4,6-dimethoxypyrimidin-2-yl)amino carbonyl]-2-(2-fluoro-1-hydroxyacetoxy-n-propyl)pyridine-3-sulfonamide

Erythro-2-(2-fluoro-1-hydroxyacetoxy-n-propyl)pyridine-3-sulfonamide(1.2g) and phenyl (4,6-dimethoxypyrimidin-2-yl)carbamate(1.33g) were reacted according to the same procedure as Example 14 to give 1.5g of the title compound as a white solid.

m.p. : 157-158℃

^{1}H NMR(200MHz, $CDCl_3$) : δ 8.8(m,1H), 8.05(m, 1H), 7.5(m, 1H), 6.7-6.8(m, 1H), 5.80(s, 1H), 5.0-5.3 (m, 1H), 4.2(m, 2H), 3.95(s, 6H), 1.45(dd, 3H)

Example 17: Synthesis of erythro-N-[(4,6-dimethoxypyrimidin-2-yl)amino carbonyl]-2-(2-fluoro-1-(3-hydroxypropion)oxy-n-propyl)pyridine-3-sulfonamide

Erythro-2-(2-fluoro-1-(3-hydroxypropion)oxy-n-propyl)pyridine-3-sulfonamide (0.11g) and phenyl (4,6-dimethoxypyrimidin-2-yl)carbamate(0.18g) were reacted according to the same procedure as Example 14 to give 0.13g of the title compound.

m.p. : 147-148℃

^{1}H NMR(200MHz, $CDCl_3$) : δ 13.3(br, 1H), 8.8(m, 1H), 8.65(m, 1H), 7.6(m, 1H), 7.3(br, 1H), 5.80(s, 1H), 5.0-5.3(m, 1H), 3.96(s, 6H), 3.6-3.9 (m, 2H), 3.4(br, 1H), 2.6(m, 2H), 1.45(dd, 3H)

Example 18: Synthesis of erythro-N-[(4,6-dimethoxypyrimidin-2-yl)amino carbonyl]-2-(2-fluoro-1-(3-methoxypropion)oxy-n-propyl)pyridine-3-sulfonamide

Erythro-2-(2-fluoro-1-(3-methoxypropion)oxy-n-propyl)pyridine-3-sulfonamide (0.29g) and phenyl (4,6-dimethoxypyrimidin-2-yl)carbamate(0.53g) were reacted according to the same procedure as Example 14 to give 0.35g of the title compound.

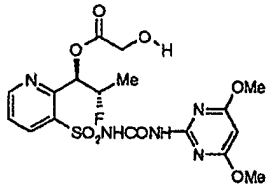
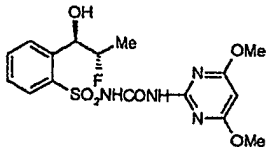
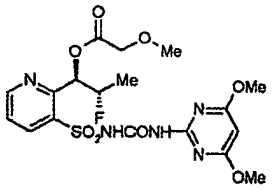
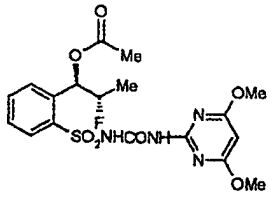
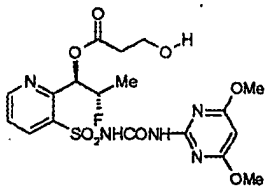
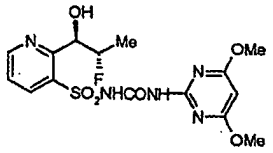
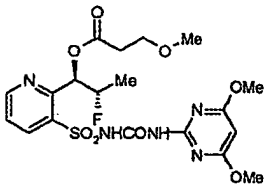
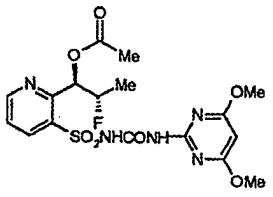
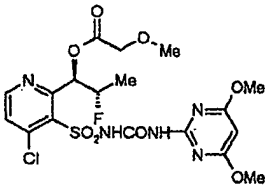
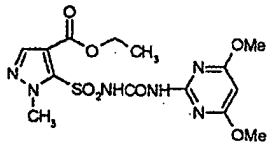
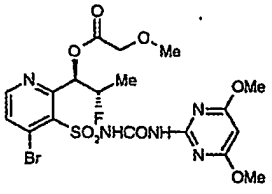
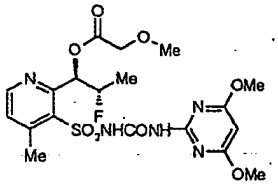
m.p. : 145-146℃

^{1}H NMR(200MHz, $CDCl_3$) : δ 8.8(m, 1H), 8.6(m, 1H), 7.5 (m, 1H), 7.2(br, 1H), 6.6(m, 1H), 5.80(s, 1H), 4.95-5.25(m, 1H), 3.95(s, 6H), 3.45(t, 2H), 3.2(s, 3H), 2.5(m, 2H), 1.5(dd, 3H)

Example 19

Herbicidal activities of the compounds according to the present invention and the known standard compounds as represented in the following Table 2 were estimated in a greenhouse.

[Table 2]

Compound of the present invention	Structure	Standard Compound	Structure
1		A	
2		B	
3		C	
4		D	
5		E	
6			
7			

Test for herbicidal activity and phytotoxicity in paddy field

Pots having a surface area of 150㎠ were filled with a small amount of fertilizer and sterilized paddy field soil in a muddy state with a depth of 5㎝. Five (5) seeds of pre-germinated rice were directly sown on the soil surface and three (3) rice seedlings (2~3 leaves) prepared in advance were transplanted in a depth of 2㎝ in each pot. In another pot, seeds of barnyardgrass were sown and incorporated into the surface layer of soil. After sowing and transplanting of rice plant and sowing of barnyardgrass, the pots were flooded with water 3㎝ deep and kept in a greenhouse. The rice plant was treated with the chemicals 5 days after sowing or transplanting, and barnyardgrass was treated with the chemicals at the pre-emergence (5 days after from sowing) and post-emergence stage (at the three-leaf stage, usually after 15 days from sowing).

Suitable herbicidal compositions were prepared by mixing and dissolving 1 part by weight of the active compound with 5 parts by weight of acetone and 1 part by weight of alkylaryl polyglycolether as an emulsifier and then diluting with water to the predetermined concentration. Application was made by dropping the herbicide solutions onto the water surface of the pots.

The test plants were observed for two weeks after the treatment with the chemicals and then herbicidal activity and phytotoxicity of the test compounds were visually rated in a percent (%) scale, where 0 means no activity or phytotoxicity and 100 means complete death.

The herbicidal activity and phytotoxicity in paddy field of the compound of formula (1) and the known standard compounds are given in the following Tables 3a and 3b, respectively.

Among the compounds, the standard compound E is Pyrazosulfuron-ethyl, which is the most widely used herbicide in rice at the present time. The standard compounds A,

B, C and D have similar structure to the compound of formula (1) of the present invention, and were filed already.

[Table 3a]

Herbicidal activity and phytotoxicity of the standard compounds in a paddy condition.

Standard Compound	*Oryza sativa*			*Echinochloa crus-galli*		
	Rate (g/ha)	Seed	Trans-planted	Rate (g/ha)	Pre-emergence	Post-emergence (3-Leaf stage)
A	80	80	70	30	100	100
	40	50	40	20	100	95
	20	40	30	10	100	90
	10	40	20	5	60	60
B	80	70	60	30	100	100
	40	50	40	20	100	90
	20	40	20	10	100	90
	10	30	20	5	50	50
C	80	70	50	30	100	100
	40	30	30	20	100	100
	20	20	20	10	100	90
	10	10	10	5	40	60
D	80	60	50	30	100	100
	40	30	20	20	100	100
	20	20	10	10	100	90
	10	10	0	5	30	50
E (Pyrazosulfuron-ethyl)	80	30	10	30	30	20
	40	20	0	20	20	0
	20	10	0	10	10	0
	10	0	0	5	0	0

As shown in Table 3a, the standard compound E, at 80 g/ha which is the four-times higher rate than the conventional application rate (20 g/ha), shows little phytotoxicity to rice; 10 or 30% to the transplanted or direct-seeded rice, respectively. Therefore, the compound E is considered to be highly safe to rice. However, it shows weak herbicidal activity to barnyardgrass (10% at 20g/ha), which is the most important weed in rice.

On the contrary, the standard compounds A to D show excellent activity to barnyardgrass, i.e., 95% or greater activity at 20g/ha by pre- or post-emergence treatments. These compounds (A~D) also show rice safety at 20 g/ha; 10 to 40% of phytotoxicity

depending on the compounds. However, for commercial development, a compound should be safe at four-times higher rates than the recommended rate. The compounds A~D show 50~80% of phytotoxicity depending on the compounds at 80g/ha, which is four times as much as the typical dose, and thus, are considered to be impossible to develop commercially.

[Table 3b]

Herbicidal activity and phytotoxicity of the compounds of the present invention in a paddy condition.

Compound	*Oryza sativa*			*Echinochloa crus-galli*		
	Rate (g/ha)	Seed	Trans-planted	Rate (g/ha)	Pre-emergence	Post-emergence (3-Leaf stage)
Com. 1	80	30	20	30	90	100
	40	30	10	20	90	90
	20	10	10	10	80	80
	10	0	0	5	50	60
Com. 2	80	30	10	30	100	100
	40	20	10	20	100	100
	20	0	0	10	100	90
	10	0	0	5	60	50
Com. 3	80	30	20	30	100	100
	40	30	20	20	95	90
	20	10	10	10	90	80
	10	0	5	5	60	60
Com. 4	80	30	20	30	100	100
	40	20	10	20	100	100
	20	0	0	10	95	90
	10	0	0	5	60	60
Com. 5	80	30	20	30	100	100
	40	20	0	20	90	90
	20	10	0	10	80	70
	10	0	0	5	50	60
Com. 6	80	20	20	30	100	100
	40	10	0	20	100	90
	20	0	0	10	80	70
	10	0	0	5	60	50
Com. 7	80	30	20	30	100	100
	40	20	10	20	90	95
	20	0	0	10	80	80
	10	0	0	5	60	50

The compounds of the present invention have excellent herbicidal activity to barnyardgrass as well as improved rice selectivity. As shown in Table 3b, the compounds of the present invention have excellent herbicidal activity against barnyardgrass; 90% or greater depending on the compounds at 20g/ha. Further, they show acceptable rice safety at 80g/ha (30% or less), which is comparable to the standard compound E.

Weed spectrum in paddy field

Pots having a surface area of 500㎠ were filled with the soil in a muddy state as mentioned above. Seeds of annual weeds such as *Monochoria vaginaiis* (MOOVA), *Lindernia procumbens* (LIDPR), *Rotala indica* (ROTIN), *Scirpus juncoides* (SCPJU), etc. were sown on the surface layer of soil, and then were planted tubers of perennial weeds such as *Cyperus serotinus* (CYPSE) and *Sagittaria pygmaea* (SAGPY) in a depth of 1㎝, and *Eleocharis kuroguwai* (ELOKU) and *Sagittaria trifolia* (SAGTR) in a depth of 4㎝. After 5 days, the chemicals were formulated as mentioned above and applied by dropping to the water surface of the pots. The test plants were observed for two weeks after the treatment and the results are given in the following Table 4.

[Table 4]

Weed spectrum of the compounds of the present invention in a paddy condition.

Compound	Rate (g/ha)	Annual weeds				Perennial weeds			
		MOOVA	LIDPR	ROTIN	SCPJU	CYPSE	SAGPY	ELOKU	SAGTR
Com. 2	20	100	100	100	100	100	95	95	90
Com. 4	20	100	100	100	100	100	90	95	85

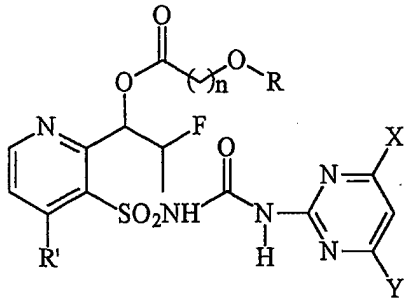
From the results of Table 4, the compounds of the present invention show high activities on various annual and perennial weeds in addition to barnyardgrass.

Consequently, the compounds of the present invention, novel herbicidal molecules in paddy conditions, effectively control the annual and perennial weeds including barnyardgrass by pre- and post-emergence treatment and provide a high level of safety to transplanted and direct-seeded rice. Therefore, they are expected to be used for such

purposes.

Claims:

1. A pyridine sulfonyl urea derivative of the following formula (1):



(1)

in which

n denotes an integer of from 1 to 3,

R represents H or C_1-C_4-alkyl,

R' represents H, C_1-C_4-alkyl, C_1-C_3-haloalkyl, halogen, or C_1-C_2-alkoxy, and

X and Y independently of one another represent C_1-C_2-alkyl, C_1-C_2-alkoxy, C_1-C_2-haloalkoxy, or halogen, salts or stereochemical isomers thereof.

2. The derivative of claim 1 wherein n denotes an integer of 1 or 2, R represents H or methyl, R' represents H, halogen or methyl, and X and Y each represents methoxy.

3. The derivative of claim 1 wherein n denotes an integer of 1 or 2, R represents methyl, R' represents H, Cl, Br or methyl, and X and Y each represents methoxy.

4. The derivative of claim 1 selected from the group consisting of:

N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-2-(2-fluoro-1-methoxy acetoxy-n-propyl)pyridine-3-sulfonamide;

N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-2-(2-fluoro-1-hydroxy acetoxy-n-propyl)pyridine-3-sulfonamide;

N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-2-(2-fluoro-1-(3-hydroxy

propion)oxy-n-propyl)pyridine-3-sulfonamide;

N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-2-(2-fluoro-1-(3-methoxypropion)oxy-n-propyl)pyridine-3-sulfonamide;

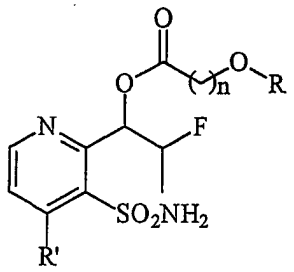
N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-4-methyl-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide;

N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-4-chloro-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide; and

N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-4-bromo-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide.

5. The derivative of claim 1 which is present in the stereoisomeric form of erythro.

6. A compound of the following formula (6):



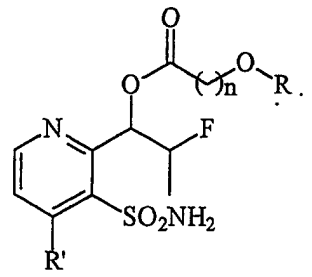
(6)

in which

n, R and R' are defined as in claim 1.

7. The compound of claim 6 which is 2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide.

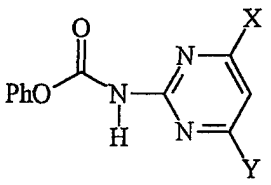
8. A process for preparing the compound of formula (1) as defined in claim 1 characterized in that a compound of the following formula (6):



(6)

in which

n, R and R' are defined as in claim 1, is reacted in a solvent optionally in the presence of a base with a compound of the following formula (7):



(7)

in which

X and Y are defined as in claim 1.

9. The process of claim 8 wherein the base is triethylamine, hexamethylenetetramine, pyridine, 1,8-diazabicyclo[5,4,0]undec-7-ene (DBU) or 1,4-diazabicyclo[2,2,2] octane (DABCO).

10. A herbicidal composition for controlling weeds which comprises as an active ingredient the compound of formula (1) as defined in claim 1 together with carriers.

11. The composition of claim 10 which comprises the compound of formula (1) wherein n denotes an integer of 1 or 2, R represents H or methyl, R' represents H, halogen or methyl, and X and Y each represents methoxy.

12. Method to use of the compound of formula (I) as defined in claim 1 for controlling weeds against rice or wheat in paddy field or upland field condition.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR00/01138

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 C07D 401/12, C07D 213/26, A01N 43/40

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimun documentation searched (classification system followed by classification symbols)
IPC 7 C07D

Documentation searched other than minimun documentation to the extent that such documents are included in the fileds searched
Korean patents and applications for inventions since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search trerms used)
CAS ON LINE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 92/14728 A (Korea Research Institute of Chemical Technology) 03 Sep. 1992. See the whole document	1-12
A	WO 96/12708 A (Korea Research Institute of Chemical Technology) 2 May 1996 See the whole document	1-12

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevence
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevence; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevence; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
05 JULY 2001 (05.07.2001)	10 JULY 2001 (10.07.2001)

Name and mailing address of the ISA/KR	Authorized officer
Korean Intellectual Property Office Government Complex-Daejeon, Dunsan-dong, Seo-gu, Daejeon Metropolitan City 302-701, Republic of Korea Facsimile No. 82-42-472-7140	CHO, Myung Sun Telephone No. 82-42-481-5605

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

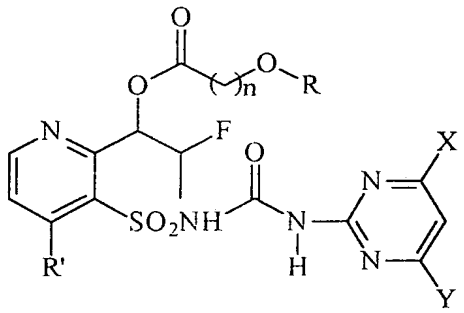
International application No.
PCT/KR00/01138

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 92/14728	03.09.1992	EP 639190 A	22.02.1995
		JP 2674878 B	12.11.1997
		KR 9309507 B	06.10.1993
		US 5461026 A	24.10.1995
WO 96/12708	02.05.1996	EP 788486 A	13.08.1997
		EP 788486 B	12.07.2000

HERBICIDALLY ACTIVE PYRIDINE SULFONYL UREA DERIVATIVES

TECHNICAL FIELD

The present invention relates to pyridine sulfonyl urea derivatives represented by the following formula (1):



(1)

in which

n denotes an integer of from 1 to 3,

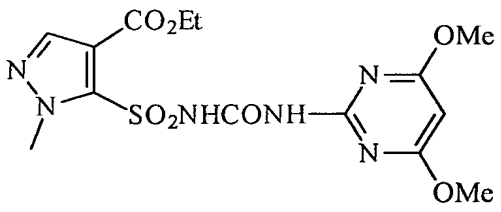
R represents H or C_1-C_4-alkyl,

R' represents H, C_1-C_4-alkyl, C_1-C_3-haloalkyl, halogen, or C_1-C_2-alkoxy, and

X and Y independently of one another represent C_1-C_2-alkyl, C_1-C_2-alkoxy, C_1-C_2-haloalkoxy, or halogen, salts or stereochemical isomers thereof showing an effective herbicidal activity in pre- and/or post-emergence treatment in rice farming, or to a method to use thereof, a method for the preparation thereof, an intermediate used for the preparation thereof, and a herbicidal composition comprising same.

BACKGROUND ART

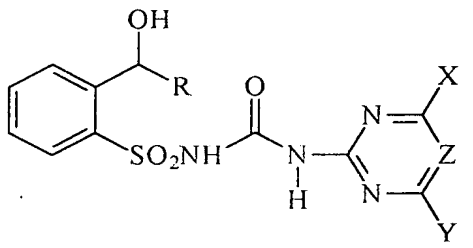
Hitherto, there have been reported a lot of sulfonyl urea derivatives having a herbicidal activity in rice farming. For example, JP 61/191602 discloses a compound represented by the following formula (2):



(2)

, which has been commercialized as a herbicide for rice farming in the name of Pyrazosulfuron-ethyl.

Korean Patent No. 70675 discloses a compound represented by the following formula (3):



(3)

in which

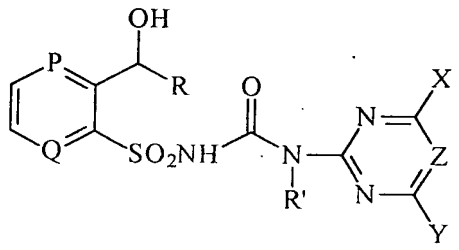
R represents haloalkyl,

X and Y independently of one another represent CH_3, OCH_3, Cl, etc., and

Z represents CH or N.

Korean Patent Application No. 91-3014 discloses a herbicidally active sulfonyl

urea derivative represented by the following formula (4):



(4)

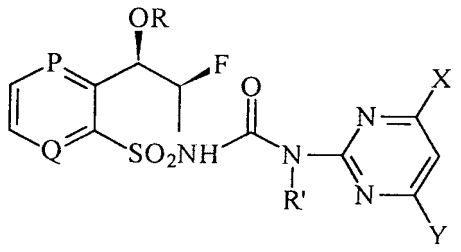
in which

R, X, Y and Z are defined as the above formula (3),

R' represents H or CH_3, and

P and Q independently of one another represent CH or N, but where the aromatic ring including P and Q is benzene or pyridine.

Korean Patent Application No. 93-6915 discloses a herbicidally active pyridine sulfonyl urea derivative represented by the following formula (5):



(5)

in which

P, Q, R', X and Y are defined as in the above formula (4),

R represents H, R^a-(C=O)- or R^a-X^a-(C=O)-, wherein R^a represents C_1~C_4-alkyl, C_1~C_3-haloalkyl, C_2~C_4-alkenyl or C_2~C_4-alkynyl, and X^a represents O, S, NH or NR^a.

The existing sulfonyl urea-based herbicidal compounds as explained above show an excellent herbicidal activity against annual and perennial weeds in rice, but have weak

activity to barnyardgrass which is the most problematic weed in rice, or cause some phytotoxicity to rice plant. The present inventors claim new pyridine sulfonyl urea derivatives having improved rice safety and superior herbicidal activity against barnyardgrass to the earlier herbicidal compounds, and find great advantages of these new compounds when used as a rice herbicide.

Therefore, one object of the present invention is to provide the pyridine sulfonyl urea derivatives of the above formula (1), salts or stereochemical isomers thereof.

It is another object of the present invention to provide a process for the preparation of the compound of formula (1).

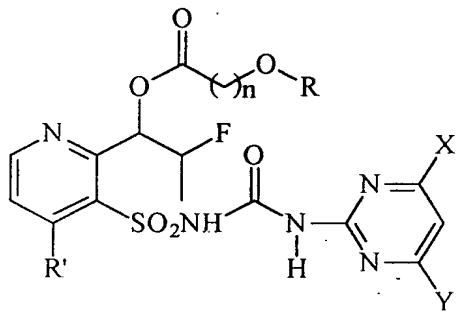
It is further object of the present invention to provide a novel intermediate which is used for the preparation of the compound of formula (1).

It is further object of the present invention to provide a method to use the compound of formula (1) as a herbicide for paddy rice, and a herbicidal composition comprising same.

The present invention will be explained in more detail hereinafter.

DISCLOSURE OF INVENTION

The present invention relates to a compound of the following formula (1):



(1)

in which

n denotes an integer of from 1 to 3,

R represents H or C_1-C_4-alkyl,

R' represents H, C_1-C_4-alkyl, C_1-C_3-haloalkyl, halogen, or C_1-C_2-alkoxy, and

X and Y independently of one another represent C_1-C_2-alkyl, C_1-C_2-alkoxy, C_1-C_2-haloalkoxy, or halogen.

Among the compound of formula (1) which shows an excellent selectivity to rice plant and herbicidal activity to barnyardgrass and thus, can be advantageously used as a herbicide for rice farming, the preferred compounds include those wherein n denotes an integer of 1 or 2, R represents H or methyl, R' represents H, halogen or methyl, and X and Y each represents methoxy.

Particularly preferred compounds include those wherein n denotes an integer of 1 or 2, R represents methyl, R' represents H, Cl, Br or methyl, and X and Y each represents methoxy.

Typical examples of the compound of formula (1) according to the present invention are exemplified as follows:

N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-2-(2-fluoro-1-methoxy acetoxy-n-propyl)pyridine-3-sulfonamide.

N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-2-(2-fluoro-1-hydroxy acetoxy-n-propyl)pyridine-3-sulfonamide.

N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-2-(2-fluoro-1-(3-hydroxy propion)oxy-n-propyl)pyridine-3-sulfonamide.

N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-2-(2-fluoro-1-(3-methoxypropion)oxy-n-propyl)pyridine-3-sulfonamide.

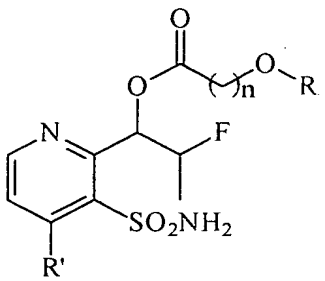
N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-4-methyl-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide.

N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-4-chloro-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide.

N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-4-bromo-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide.

Since the compound of formula (1) has two asymmetric carbons therein, they can exist as an erythro or threo isomer, or mixtures thereof. The compound of the present invention shows a stronger activity in the erythro form, but the mixtures thereof in a suitable mixing ratio also exhibit a sufficient activity.

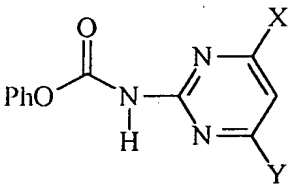
The compound of formula (1) according to the present invention can be prepared by a process characterized in that a compound represented by the following formula (6):



(6)

in which

n, R and R' are defined as in the above formula (1), is reacted in a solvent optionally in the presence of a base with a compound represented by the following formula (7):



(7)

in which

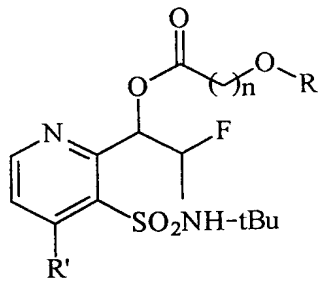
X and Y are defined as in the above formula (1). Therefore, it is another object of the present invention to provide such a preparation process.

The compound of formula (6) used as a starting material in the process according to the present invention can exist as an erythro isomer, threo isomer, or mixtures thereof. The stereo-chemical configuration of the desired compound of formula (1) may be determined in line with the configuration of compound (6).

Any solvent which does not adversely affect the reaction can be used in the above process, but preferably tetrahydrofuran, acetone, acetonitrile, dioxane, methylene chloride, toluene, butanol, pyridine, dimethylformamide, etc. can be used. The above process is carried out preferably in the presence of a small amount of strong base, such as for example, triethylamine, hexamethylenetetramine, pyridine, DBU or DABCO (wherein DBU means 1,8-diazabicyclo[5,4,0]undec-7-ene and DABCO means 1,4-diazabicyclo[2,2,2]octane, and they have the same meaning throughout the present specification), etc., and the reaction temperature may be preferably maintained in the range of 10~80℃. The specific reaction conditions can be referred to USP 4,443,245 which discusses similar reactions, and after the reaction is completed, the desired compound can be obtained through the acid-treatment procedure as described in EP 044,807. If a highly pure compound is required, it is desirable to use HPLC technique.

The compound of formula (7) was known and can be easily prepared according to the process described in Korean Patent No. 70,675.

The compound of formula (6) is a novel intermediate which is provided first by the present invention. Therefore, it is another subject matter to be provided by the present invention. The compound of formula (6) can be prepared by treating a compound represented by the following formula (8):

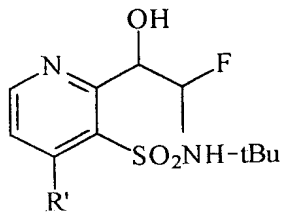


(8)

in which, n, R and R' are defined as formula (1), with trifluoroacetic acid (TFA) to eliminate the t-butyl group therefrom.

If the compound of formula (8) is stirred in the solvent of trifluoroacetic acid(TFA) at 0~80°C, the t-butyl group is eliminated to give the sulfonamide compound of formula (6). When the compound of formula (6) thus obtained is present in the form of an erythro-threo mixture, it may be resolved by column chromatography, HPLC or preparative-TLC method to give pure erythro or threo compound.

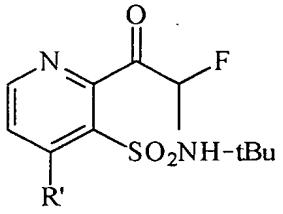
The compound of formula (8) may also be prepared by acylating a compound represented by the following formula (9) according to a conventional manner:



(9)

in which R' is defined as in the above formula (1).

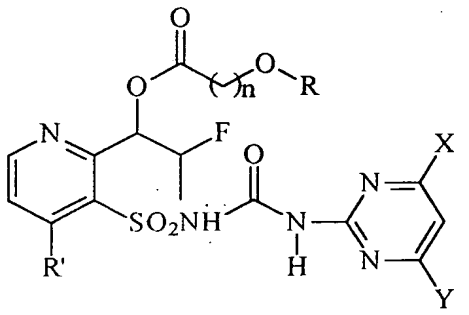
The compound of formula (9) may be prepared by selectively reducing a compound represented by the following formula (10):



(10)

in which R' is defined as in the above formula (1), using a suitable reducing agent, such as for example, DIBAL· H(Diisobutylaluminum hydride), $NaBH_4$, $LiAlH_4$, BH_3.

The compound of formula (1) as can be prepared as explained above is more definitely exemplified individually in the following Table 1.



[Table 1]

R'	n	R	X	Y	m.p.(°C)
Cl	1	CH_3	Ome	OMe	135-140
Br	1	CH_3	Ome	OMe	87-89
Br	1	H	Ome	OMe	
OCH_3	1	CH_3	Ome	OMe	
CH_3	1	CH_3	Ome	OMe	156-158
CF_3	1	CH_3	Ome	OMe	
H	1	H	Ome	OMe	157-158
CH_3	2	CH_3	Ome	OMe	
H	1	CH_3	Ome	OMe	175-177(erythro)
H	1	CH_3	Ome	OMe	152-154(threo)
H	1	CH_3	Ome	Cl	
H	1	CH_3	Me	Me	
H	2	H	Ome	OMe	147-148
H	2	CH_3	Ome	OMe	145-146

The compound of formula (1) according to the present invention may exist as a suitable salt and is utilizable as a herbicide in that form. The salt can be prepared by a conventional method known per se, for example, by contacting the compound of formula (1) with a solution containing hydroxide, alkoxide, or carbonate of alkali metal or alkaline earth metal. Otherwise, the salt may be prepared by using an amine compound in the similar manner.

Various salts can also be obtained by exchanging the cation of the salt of compound of formula (1) by another one. Cation exchange is carried out by directly contacting a salt of the compound of formula (1), for example, alkali metal salt or quarternary amine salt in aqueous solution with a solution containing the cation to be

newly combined. This method is the most effective when the resulting salt containing the newly combined cation is insoluble in water. Ion exchange can also be carried out by subjecting a salt of the compound of formula (1), for example, alkali metal salt or quarternary amine salt in aqueous solution to a column filled with cation exchange resin containing the cation to be newly combined. In this case, the cation in the resin is exchanged with the cation of the original salt and the desired salt newly formed is eluted from the column. This method is particularly effective when the resulting salt is water-soluble, that is, sodium, potassium or calcium salt.

Further, the compound of formula (1) is conveniently used as a herbicidal agent when it is present in the form of mixtures or complexes with urea or amide compound. Those mixtures or complexes may be prepared according to the typical methods.

The preparation or conversion process as briefly summarized above may be easily carried out by a person skilled in the area of organic synthesis or synthesis of sulfonyl urea derivatives. All the processes designed from the present description by conventional modifications fall within the scope of the present invention.

As stated already, the pyridine sulfonyl urea derivative of formula (1) according to the present invention can be used as a herbicidal agent. Therefore, the utilities and formulations are explained below.

[Utility]

Since the compound of formula (1) has an excellent selectivity for rice plant as well as a potent herbicidal activity, it can be used as a herbicide for paddy rice and can be contained as an active ingredient in herbicidal composition.

Test results indicate that the compound of formula (1) is highly active as a herbicide for pre- or post-emergence treatment in paddy and upland.

The rates of application of the active compound of the invention are determined by a number of factors, including the types of weeds to be controlled, weather, climate, formulations selected, mode of application, size of weeds, etc. In general terms, the subject compounds should be applied at levels of around 1g to 1 kg/ha, the lower rates being suggested for use on soils having a low organic matter content or sandy soil, for young plants, or for situations where only short-term persistence is required. Particularly, the subject compounds may be used effectively in rice to control various weeds including barnyardgrass, annual broadleaf and sedge weeds as well as perennial weeds.

The compounds of the present invention may be used alone or as two-, three-, or four-way combinations together with the existing herbicides.

[Formulation]

In the present invention, the compound of formula (1) is used in the form of a conventional composition. If necessary, the compound of formula (1) is applied to plant, soil, or water surface in combination with carriers, surfactants, adjuvants, or other additives which are conveniently used in the technical field of formulation.

Suitable carriers and additives may be a solid or a liquid and include those components effectively used in the field of formulation, such as for example, natural or synthetic inorganic substances, solvents, dispersants, wetting agents, adhesive agents, thickening agents, binding agents, etc.

The composition comprising the compound of formula (1) is preferably applied to soil in the form of a solid, for example, a granule, or liquid (soil treatment). Otherwise, the composition comprising the compound of formula (1) may be applied directly to a plant foliage (foliar treatment). Frequency and rate of application are varied depending

on the biological characteristics of plants, weather, soil types, and other environmental conditions.

The active ingredient-containing combinations in unmodified form can be used together with the known adjuvants conveniently used in the field of formulation. They are formulated according to the known methods to emulsifiable concentrates, liquid formulations which can be diluted, liquid hydrates which can be directly applied to water surface, developing agent for water surface, emulsions, hydrates, powders, dusts, granules or tablets. Application methods such as spraying, dusting, broadcasting, etc. and characteristics of the composition are selected to be compatible with the purpose of use and environments. The rate of application of the active ingredient-containing combination varies generally in the range of from 1g to 1kg a.i./ha, preferably from 10g to 30g a.i./ha.

For example, the active ingredient may be intimately mixed and/or pulverized with extenders[e.g. solvents, solid carriers and if desired, surface-active compounds (surfactants)] according to the known methods to give the combinations.

Possible solvents include the following: aromatic hydrocarbons such as xylene mixtures or substituted naphthalenes; alcohols and glycols, and their ethers and esters such as ethanol, ethylene glycol, ethylene glycol monomethyl or monoethyl ether; ketones such as cyclohexanone; strongly polar solvents such as N-methyl-2-pyrrolidone, dimethylsulfoxide or dimethylformamide; optionally epoxidised vegetable oils such as epoxidised coconut oil or soybean oil; and water. These solvents can be used as emulsifying agents, solvents for liquid formulation or cosolvents for granule formulation.

The solid carriers used e.g. for dusts and granules, are normally pulverized natural mineral fillers such as talc, kaolin, montmorillonite, pyrophyllite, bentonite, calcite, or adsorptive carriers such as zeolite, or sand. In addition, a great number of prepulverized materials of inorganic or organic nature can be used.

Depending on the nature of the compound of formula (1) to be formulated, suitable surface-active compounds are nonionic, cationic and/or anionic surfactants having good dispersing, wetting and lubricating properties. The term "surfactants" will also be understood as comprising mixtures of surfactants.

The herbicidal compositions, broadly, contain 0.1 to 99% by weight, preferably 0.1 to 95% by weight of the compound of formula (1), 99.9 to 1% by weight, preferably 99.9 to 5% by weight of solid or liquid additives, and 0 to 25% by weight, preferably 0.1 to 25% by weight of surfactant.

These compositions fall within the scope of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

The process for the preparation and use of the compound according to the present invention will be more specifically explained in the following Examples. However, it should be understood that these Examples are intended to illustrate the present invention but not in any manner to limit the scope of the present invention. Unless otherwise stated, C18 silica(25-40μm, 50㎖) column equilibrated with acetonitrile/water=10/90(v/v) was used as the stationary phase of column chromatography in the following Examples.

Example 1: Synthesis of erythro-N-t-butyl-4-methyl-2-(2-fluoro-1-hydroxy-n-propyl)pyridine-3-sulfonamide

Erythro-N-t-butyl-2-(2-fluoro-1-hydroxy-n-propyl)pyridine-3-sulfonamide (2.55g) was dissolved in THF(150㎖) which had been well purified and then 2.5N n-BuLi(13.4㎖) was slowly added thereto under nitrogen gas at -78℃. The reaction temperature was raised to -20℃ and cooled down to -78℃ again. CuI(2.10g) was introduced into

another flask and the lithium salt prepared above was reversely added to this flask. After 10 minutes, CH_3I(0.83㎖) was added, the resulting mixture was stirred for 30 minutes at -78℃, and the reaction was quenched with NH_4Cl solution. Ethyl acetate was added to the reaction solution to separate the organic layer. The aqueous layer was extracted with ethyl acetate, and then the organic layers were combined, dried($MgSO_4$), filtered and concentrated to give a crude product. This crude product was subjected to column chromatography (Moving phase: ethyl acetate/n-hexane=1/2, v/v) to give 0.5g of the pure title compound.

^{1}H NMR(200MHz, $CDCl_3$) : δ 8.55(d, 1H, J=5Hz), 7.24(d, 1H, J=5Hz), 6.1 (br s, 1H), 4.6～4.9(m, 3H), 2.76(s, 3H), 1.35(dd, 3H, J_1=25Hz, J_2=6Hz), 1.26 (s, 9H)

Example 2: Synthesis of erythro-4-methyl-2-(2-fluoro-1-methoxy- acetoxy-n-propyl)pyridine-3-sulfonamide

Erythro-N-t-butyl-4-methyl-2-(2-fluoro-1-hydroxy-n-propyl)pyridine-3-sulfonamide(0.7g) was dissolved in THF(10㎖) and methoxyacetylchloride(0.32g) was added thereto. 60% NaH(0.13g) was added at 0℃ and the resulting mixture was stirred for 2 hours at room temperature. The reaction was quenched with saturated aqueous NH_4Cl solution and extracted with ethyl acetate. The organic layer was dried($MgSO_4$), filtered and concentrated, and the residue was subjected to column chromatography(Moving phase: ethyl acetate/n-hexane=1/3, v/v) to give erythro-N-t-butyl-4-methyl-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide(0.7g).

To the resulting product was added CF_3CO_2H(10㎖) and the mixture was stirred for 1 hour at 60～65℃. The reaction solution was concentrated under reduced pressure and the residue was dissolved in methylene chloride and washed with aqueous sodium bicarbonate solution. The organic layer was dried($MgSO_4$), filtered and concentrated, and the residue was subjected to column chromatography (Moving phase: ethyl acetate/methylene chloride=1/7→ 1/1, v/v) to give 0.37g of the pure title compound.

^{1}H NMR(200MHz, $CDCl_3$) : δ 8.57(d, 1H, J=5Hz), 7.24(d, 1H, J=5Hz), 6.85～6.95(m, 1H), 5.65(br s, 2H), 4.9～5.3(m, 1H), 4.13(s, 2H), 3.41(s, 2H), 2.72(s, 3H), 1.55(dd, 3H, J_1=25Hz, J_2=6Hz)

Example 3: Synthesis of erythro-N-t-butyl-4-chloro-2-(2-fluoro-1-hydroxy-n-propyl)pyridine-3-sulfonamide

Erythro-N-t-butyl-2-(2-fluoro-1-hydroxy-n-propyl)pyridine-3-sulfonamide(0.29g) was dissolved in THF(10㎖) which had been well purified and then 2.5N n-BuLi(1.52㎖) was slowly added thereto under nitrogen gas at -78℃. The reaction temperature was raised to -20℃ and cooled down to -78℃ again. NCS(N-chlorosuccinimide)(0.2g) dissolved in THF(5㎖) was slowly added to the reaction solution. After 30 minutes, the reaction was quenched with saturated aqueous ammonium chloride solution. Ethyl acetate was added to the reaction solution to separate the organic layer. The aqueous layer was extracted once more with ethyl acetate, and then the organic layers were combined, dried ($MgSO_4$), filtered and concentrated to give a crude product. This crude product was subjected to column chromatography (Moving phase: ethyl acetate/n-hexane=1/2, v/v) to give 0.18g of the pure title compound.

^{1}H NMR(200MHz, $CDCl_3$) : δ 8.61(d, 1H, J=5Hz), 7.50(d, 1H, J=5Hz), 6.05～6.15(br s, 1H), 5.2(br s, 1H), 4.6～4.9(m, 2H), 1.35(dd, 3H, J_1=25Hz, J_2=6Hz), 1.25(s, 9H)

Example 4: Synthesis of erythro-N-t-butyl-4-chloro-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide

Erythro-N-t-butyl-4-chloro-2-(2-fluoro-1-hydroxy-n-propyl)pyridine-3-sulfonamide(0.75g) was dissolved in THF(10㎖) and methoxyacetylchloride(0.33g) was added thereto. The reaction solution was cooled down to 0℃ and 60% NaH (0.13g) was added. The resulting solution was warmed to room temperature and stirred for 2 hours.

^{1}H NMR(200MHz, $CDCl_3$) : δ 8.57(d, 1H, J=5Hz), 7.24(d, 1H, J=5Hz), 6.85～6.95(m, 1H), 5.65(br s, 2H), 4.9～5.3(m, 1H), 4.13(s, 2H), 3.41(s, 2H), 2.72(s, 3H), 1.55(dd, 3H, J_1=25Hz, J_2=6Hz)

Example 3: Synthesis of erythro-N-t-butyl-4-chloro-2-(2-fluoro-1-hydroxy-n-propyl)pyridine-3-sulfonamide

Erythro-N-t-butyl-2-(2-fluoro-1-hydroxy-n-propyl)pyridine-3-sulfonamide(0.29g) was dissolved in THF(10㎖) which had been well purified and then 2.5N n-BuLi(1.52㎖) was slowly added thereto under nitrogen gas at -78℃. The reaction temperature was raised to -20℃ and cooled down to -78℃ again. NCS(N-chlorosuccinimide)(0.2g) dissolved in THF(5㎖) was slowly added to the reaction solution. After 30 minutes, the reaction was quenched with saturated aqueous ammonium chloride solution. Ethyl acetate was added to the reaction solution to separate the organic layer. The aqueous layer was extracted once more with ethyl acetate, and then the organic layers were combined, dried ($MgSO_4$), filtered and concentrated to give a crude product. This crude product was subjected to column chromatography (Moving phase: ethyl acetate/n-hexane=1/2, v/v) to give 0.18g of the pure title compound.

^{1}H NMR(200MHz, $CDCl_3$) : δ 8.61(d, 1H, J=5Hz), 7.50(d, 1H, J=5Hz), 6.05～6.15(br s, 1H), 5.2(br s, 1H), 4.6～4.9(m, 2H), 1.35(dd, 3H, J_1=25Hz, J_2=6Hz), 1.25(s, 9H)

Example 4: Synthesis of erythro-N-t-butyl-4-chloro-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide

Erythro-N-t-butyl-4-chloro-2-(2-fluoro-1-hydroxy-n-propyl)pyridine-3-sulfonamide(0.75g) was dissolved in THF(10㎖) and methoxyacetylchloride(0.33g) was added thereto. The reaction solution was cooled down to 0℃ and 60% NaH (0.13g) was added. The resulting solution was warmed to room temperature and stirred for 2 hours.

The reaction was quenched with aqueous ammonium chloride solution. The reaction solution was extracted with ethyl acetate and the organic layer was dried ($MgSO_4$), filtered and concentrated. The residue was subjected to column chromatography (Moving phase: ethyl acetate/n-hexane=1/3, v/v) to give 0.7g of the pure title compound.

^1H NMR(200MHz, $CDCl_3$) : δ 8.60(d, 1H, J=5Hz), 7.46(d, 1H, J=5Hz), 7.05~7.15(m, 1H), 5.45(br s, 1H), 4.9~5.3(m, 1H), 2.1(s, 3H), 1.44(dd, 3H, J_1 =25Hz, J_2=6Hz), 1.31(s, 9H)

Example 5: Synthesis of erythro-N-t-butyl-4-bromo-2-(2-fluoro-1-hydroxy-n-propyl)pyridine-3-sulfonamide

Erythro-N-t-butyl-2-(2-fluoro-1-hydroxy-n-propyl)pyridine-3-sulfonamide(7.0g) was dissolved in THF(200㎖) which had been well purified and then 2.5N n-BuLi (13.4㎖) was slowly added thereto under nitrogen gas at -78℃. The reaction temperature was raised to -20℃ and cooled down to -78℃ again. NBS(N-bromosuccinimide)(6.4g) was added to the reaction solution and the resulting mixture was stirred for 30minutes. The reaction was quenched with saturated aqueous ammonium chloride solution. Ethyl acetate was added to the reaction solution to separate the organic layer. The aqueous layer was extracted once more with ethyl acetate, and then the organic layers were combined, dried ($MgSO_4$), filtered and concentrated to give a crude product. This crude product was subjected to column chromatography (Moving phase: ethyl acetate/n-hexane=1/2, v/v) to give 3.9g of the pure title compound.

^1H NMR(200MHz, $CDCl_3$) : δ 8.48(d, 1H, J=5Hz), 7.74(d, 1H, J=5Hz), 6.5(br s, 1H), 5.39(br s, 1H), 4.6~4.95(m, 2H), 1.32(dd, 3H, J_1=25Hz, J_2=6Hz), 1.25(s, 9H)

Example 6: Synthesis of erythro-4-bromo-2-(2-fluoro-1-hydroxy-n-propyl) pyridine-3-sulfonamide

Erythro-N-t-butyl-4-bromo-2-(2-fluoro-1-hydroxy-n-propyl)pyridine-3-sulfonamide(0.5g) was dissolved in trifluoroacetic acid(CF_3CO_2H; 10㎖) and the resulting solution was stirred for 2 hours at 60～65℃. The reaction solution was concentrated under reduced pressure, and then the filtrate was diluted with methylene chloride and concentrated. The residue was subjected to column chromatography (Moving phase: ethyl acetate/methylene chloride=1/7→ 1/1, v/v) to give 0.3g of the pure title compound.

^{1}H NMR(200MHz, $CDCl_3$) : δ 8.49(d, 1H, J=5Hz), 7.75(d, 1H, J=5Hz), 6.0～6.06(m, 1H), 5.45(br s, 2H), 4.15～4.55(m, 1H), 3.46(br s, 1H), 1.53(dd, 3H, J_1 =25Hz, J_2=6Hz)

Example 7: Synthesis of erythro-N-[(4,6-dimethoxypyrimidin-2-yl)amino carbonyl]-4-chloro-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide

Erythro-4-chloro-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide (0.5g) was dissolved in acetonitrile(10㎖) and phenyl (4,6-dimethoxypyrimidin-2-yl)carbamate(0.86g) was added thereto at room temperature. DBU(0.48g) was slowly added and the reaction solution was stirred for 30minutes, diluted with methylene chloride(100㎖) and washed with 5% aqueous hydrochloric acid solution(50㎖). The organic layer was dried ($MgSO_4$), filtered and concentrated. The residue was recrystallized from diethylether/n-hexane to give 0.61g of the pure title compound as a white solid.

m.p. : 135～140℃

^{1}H NMR(200MHz, $CDCl_3$) : δ 13.2(br s, 1H), 8.63(d, 1H, J=5Hz), 7.45(d, 1H, J=5Hz), 7.2～7.4(m, 2H), 5.81(s, 1H), 4.82～5.22(m, 1H), 3.97(s, 6H), 1.44(dd, 3H, J_1=25Hz, J_2=6Hz)

Example 8: Synthesis of erythro-N-[(4,6-dimethoxypyrimidin-2-yl)amino carbonyl]-4-bromo-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide

Erythro-4-bromo-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide (0.82g) and phenyl (4,6-dimethoxypyrimidin-2-yl)carbamate(0.86g) were reacted according to the same procedure as Example 7 to give 0.85g of the title compound as a white solid.

m.p. : 87-89℃

^{1}H NMR(200MHz, $CDCl_3$) δ 8.49(d, 1H, J=5Hz), 7.65(d, 1H, J=5Hz), 7.23(s, 1H), 7.02-7.1(m, 1H), 5.80(s, 1H), 5.22-5.58(m, 1H), 4.13(s, 2H), 3.96(s, 6H), 3.41(s, 3H), 1.48(dd, 3H, J_1=25Hz, J_2=6Hz)

Example 9: Synthesis of erythro-N-[(4,6-dimethoxypyrimidin-2-yl)amino carbonyl]-4-methyl-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide

Erythro-4-methyl-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide (0.73g) and phenyl (4,6-dimethoxypyrimidin-2-yl)carbamate(0.86g) were reacted according to the same procedure as Example 7 to give 0.75g of the title compound as a white solid.

m.p. : 156-158℃

^{1}H NMR(200MHz, $CDCl_3$) δ 8.58(d, 1H, J=5Hz), 7.23(d, 1H, J=5Hz), 7.21 (br s, 1H), 6.65-6.75(m, 1H), 5.78(s, 1H), 5.05-5.38(m, 1H), 4.13(s, 2H), 3.97(s, 6H), 3.41(s, 3H), 2.89(s, 3H), 1.47(dd, 3H, J_1=25Hz, J_2=6Hz)

Example 10: Synthesis of erythro-2-(2-fluoro-1-methoxyacetoxy-n-propyl) pyridine-3-sulfonamide and threo-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide

1:1 mixture of erythro and threo isomers of N-t-butyl-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide(5.0g) was dissolved in trifluoroacetic

acid(20㎖). The reaction solution was stirred for 12 hours at 45℃ and concentrated under reduced pressure. The residue was dissolved in methylene chloride, which was then washed with aqueous sodium bicarbonate solution. The organic layer was dried over anhydrous magnesium sulfate and the residue was subjected to column chromatography (Moving phase: ethyl acetate/methylene chloride=1/7→ 1/1, v/v) to give 1.0g of the title compound in the pure erythro form and 1.0g of the title compound in the pure threo form, respectively, as a solid.

Erythro compound.

^{1}H NMR(200MHz, $CDCl_3$) : δ 8.82-8.85(m, 1H), 8.35-8.38(m, 1H), 7.43-7.50 (m, 1H), 6.60-6.72(m, 1H), 5.68(brs, 2H), 4.93-5.29(m, 1H), 4.18(s, 2H), 3.2(s, 3H), 1.55(dd, 3H, J_{H-H}=6.5Hz, J_{H-F}=25Hz),

Threo compound

^{1}H NMR(270MHz, $CDCl_3$) : δ 8.82-8.85(m, 1H), 8.35-8.38(m, 1H), 7.43-7.50 (m, 1H), 6.60-6.72(m, 1H), 5.58(brs, 2H), 5.29-5.40(m, 1H), 4.18(s, 2H), 3.43(s, 3H), 1.20(dd, 3H, J_{H-H}=6.5Hz, J_{H-F}=25Hz)

Example 11: Synthesis of erythro-2-(2-fluoro-1-hydroxyacetoxy-n-propyl) pyridine-3-sulfonamide

Erythro-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide(0.5g) was dissolved in chloroform(10㎖), iodotrimethylsilane(0.9㎖) was added thereto, and the resulting mixture was stirred for 12 hours at 60℃. The reaction solution was concentrated and the residue was subjected to C18 silica(50㎖) column chromatography (Moving phase: CH_3CN/H_2O=10/90, v/v) to give 0.22g of the title compound.

m.p. : 142-143℃

^{1}H NMR(200MHz, D_2O) : δ 8.82-8.85(m, 1H), 8.35-8.38(m, 1H), 7.43- 7.50(m, 1H), 5.0-5.4(m, 1H), 4.4(d, 2H), 1.55(dd, 3H)

Example 12: Synthesis of erythro-2-(2-fluoro-1-(3-methoxypropion)oxy-n-propyl)pyridine-3-sulfonamide

Erythro-N-t-butyl-2-(2-fluoro-1-(3-methoxypropion)oxy-n-propyl)pyridine-3-sulfonamide(5.0g) was reacted according to the same procedure as Example 10 to give 2.0g of the title compound.

^{1}H NMR(200MHz, $CDCl_3$) : δ 8.82-8.85(m, 1H), 8.35-8.38(m, 1H), 7.43-7.50 (m, 1H), 6.60-6.72(m, 1H), 5.75(brs, 2H), 4.93-5.29(m, 1H), 3.62(t, 2H), 3.3(s, 3H), 2.7(m, 2H), 1.55(dd, 3H)

Example 13: Synthesis of erythro-2-(2-fluoro-1-(3-hydroxypropion)oxy-n-propyl)pyridine-3-sulfonamide

Erythro-2-(2-fluoro-1-(3-methoxypropion)oxy-n-propyl)pyridine-3-sulfonamide (0.56g) was reacted according to the same procedure as Example 11 to give 0.12g of the title compound.

^{1}H NMR(200MHz, D_2O) : δ 8.8(m, 1H), 8.4(m, 1H), 7.45(m, 1H), 6.9(brs, 2H), 6.75(m, 1H), 5.0-5.3(m, 1H), 3.8(m, 2H), 2.6(t, 2H), 1.55(dd, 3H)

Example 14: Synthesis of erythro-N-[(4,6-dimethoxypyrimidin-2-yl)amino carbonyl]-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide

Erythro-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide(3.9g) was dissolved in acetonitrile(20㎖), phenyl (4,6-dimethoxypyrimidin-2-yl)carbamate (3.57g) was added, and then triethylamine(1.32g) was slowly added thereto. The reaction solution was stirred for 2 hours, diluted with methylene chloride(20㎖) and then washed with 5% aqueous hydrochloric acid solution(10㎖) and water(10㎖). The organic layer

was dried over magnesium sulfate, filtered and concentrated. The residue was recrystallized from ethyl acetate/hexane/diethylether to give 4.5g of the title compound.

m.p. : 175-177℃

^{1}H NMR(200MHz, $CDCl_3$) : δ 13.2(br, 1H), 8.8(m, 1H), 8.6(m, 1H), 7.5(m, 1H), 7.2(br, 1H), 6.6(m, 1H), 5.80(s, 1H), 5.0-5.3(m, 1H), 4.05(s, 2H), 3.96(s, 6H), 3.25(s, 3H), 1.45(dd, 3H)

Example 15: Synthesis of threo-N-[(4,6-dimethoxypyrimidin-2-yl)amino carbonyl]-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide

Threo-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide (1.56g) and phenyl (4,6-dimethoxypyrimidin-2-yl)carbamate(2.99g) were reacted according to the same procedure as Example 14 to give 1.8g of the title compound as a white solid.

m.p. : 152-154℃

^{1}H NMR(200MHz, $CDCl_3$) : δ 13.2(br, 1H), 8.81(m, 1H), 8.67(m, 1H), 7.50(m, 1H), 7.49(br, 1H), 6.67(m, 1H), 5.80(s, 1H), 5.0-5.3(m, 1H), 4.05 (s, 2H), 3.96(s, 6H), 3.25(s, 3H), 1.28(dd, 3H)

Example 16: Synthesis of erythro-N-[(4,6-dimethoxypyrimidin-2-yl)amino carbonyl]-2-(2-fluoro-1-hydroxyacetoxy-n-propyl)pyridine-3-sulfonamide

Erythro-2-(2-fluoro-1-hydroxyacetoxy-n-propyl)pyridine-3-sulfonamide(1.2g) and phenyl (4,6-dimethoxypyrimidin-2-yl)carbamate(1.33g) were reacted according to the same procedure as Example 14 to give 1.5g of the title compound as a white solid.

m.p. : 157-158℃

^{1}H NMR(200MHz, $CDCl_3$) : δ 8.8(m,1H), 8.05(m, 1H), 7.5(m, 1H), 6.7-6.8(m, 1H), 5.80(s, 1H), 5.0-5.3 (m, 1H), 4.2(m, 2H), 3.95(s, 6H), 1.45(dd, 3H)

Example 17: Synthesis of erythro-N-[(4,6-dimethoxypyrimidin-2-yl)amino carbonyl]-2-(2-fluoro-1-(3-hydroxypropion)oxy-n-propyl)pyridine-3-sulfonamide

Erythro-2-(2-fluoro-1-(3-hydroxypropion)oxy-n-propyl)pyridine-3-sulfonamide (0.11g) and phenyl (4,6-dimethoxypyrimidin-2-yl)carbamate(0.18g) were reacted according to the same procedure as Example 14 to give 0.13g of the title compound.

m.p. : 147-148℃

^{1}H NMR(200MHz, $CDCl_3$) : δ 13.3(br, 1H), 8.8(m, 1H), 8.65(m, 1H), 7.6(m, 1H), 7.3(br, 1H), 5.80(s, 1H), 5.0-5.3(m, 1H), 3.96(s, 6H), 3.6-3.9 (m, 2H), 3.4(br, 1H), 2.6(m, 2H), 1.45(dd, 3H)

Example 18: Synthesis of erythro-N-[(4,6-dimethoxypyrimidin-2-yl)amino carbonyl]-2-(2-fluoro-1-(3-methoxypropion)oxy-n-propyl)pyridine-3-sulfonamide

Erythro-2-(2-fluoro-1-(3-methoxypropion)oxy-n-propyl)pyridine-3-sulfonamide (0.29g) and phenyl (4,6-dimethoxypyrimidin-2-yl)carbamate(0.53g) were reacted according to the same procedure as Example 14 to give 0.35g of the title compound.

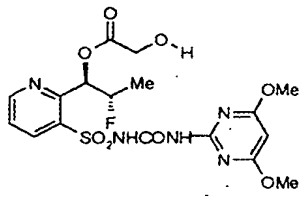
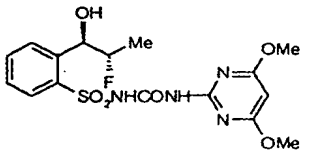
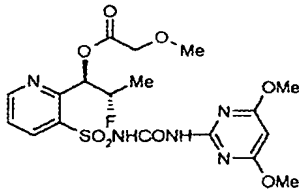
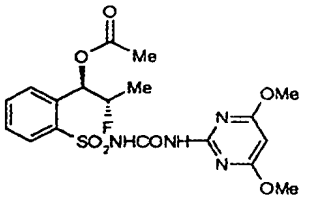
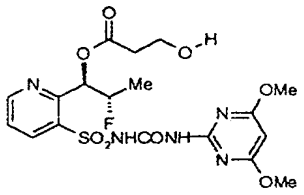
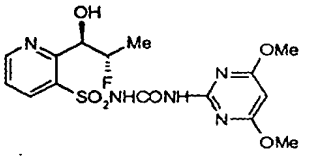
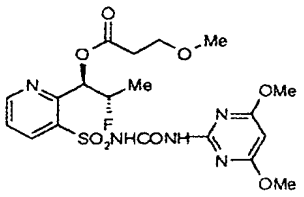
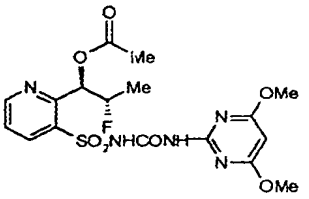
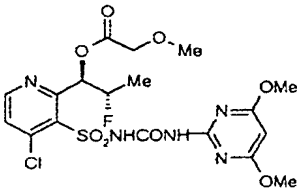
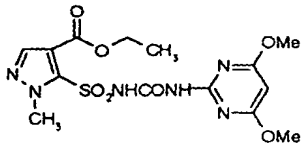
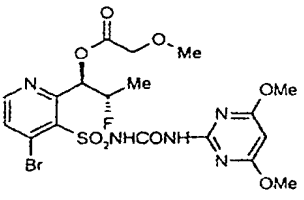
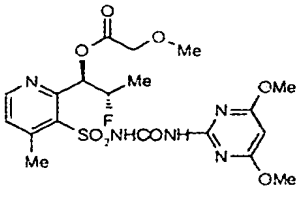
m.p. : 145-146℃

^{1}H NMR(200MHz, $CDCl_3$) : δ 8.8(m, 1H), 8.6(m, 1H), 7.5 (m, 1H), 7.2(br, 1H), 6.6(m, 1H), 5.80(s, 1H), 4.95-5.25(m, 1H), 3.95(s, 6H), 3.45(t, 2H), 3.2(s, 3H), 2.5(m, 2H), 1.5(dd, 3H)

Example 19

Herbicidal activities of the compounds according to the present invention and the known standard compounds as represented in the following Table 2 were estimated in a greenhouse.

[Table 2]

Compound of the present invention	Structure	Standard Compound	Structure
1		A	
2		B	
3		C	
4		D	
5		E	
6			
7			

Test for herbicidal activity and phytotoxicity in paddy field

Pots having a surface area of 150㎠ were filled with a small amount of fertilizer and sterilized paddy field soil in a muddy state with a depth of 5㎝. Five (5) seeds of pre-germinated rice were directly sown on the soil surface and three (3) rice seedlings (2~3 leaves) prepared in advance were transplanted in a depth of 2㎝ in each pot. In another pot, seeds of barnyardgrass were sown and incorporated into the surface layer of soil. After sowing and transplanting of rice plant and sowing of barnyardgrass, the pots were flooded with water 3㎝ deep and kept in a greenhouse. The rice plant was treated with the chemicals 5 days after sowing or transplanting, and barnyardgrass was treated with the chemicals at the pre-emergence (5 days after from sowing) and post-emergence stage (at the three-leaf stage, usually after 15 days from sowing).

Suitable herbicidal compositions were prepared by mixing and dissolving 1 part by weight of the active compound with 5 parts by weight of acetone and 1 part by weight of alkylaryl polyglycolether as an emulsifier and then diluting with water to the predetermined concentration. Application was made by dropping the herbicide solutions onto the water surface of the pots.

The test plants were observed for two weeks after the treatment with the chemicals and then herbicidal activity and phytotoxicity of the test compounds were visually rated in a percent (%) scale, where 0 means no activity or phytotoxicity and 100 means complete death.

The herbicidal activity and phytotoxicity in paddy field of the compound of formula (I) and the known standard compounds are given in the following Tables 3a and 3b, respectively.

Among the compounds, the standard compound E is Pyrazosulfuron-ethyl, which is the most widely used herbicide in rice at the present time. The standard compounds A,

B, C and D have similar structure to the compound of formula (1) of the present invention, and were filed already.

[Table 3a]

Herbicidal activity and phytotoxicity of the standard compounds in a paddy condition.

Standard Compound	*Oryza sativa*			*Echinochloa crus-galli*		
	Rate (g/ha)	Seed	Trans-planted	Rate (g/ha)	Pre-emergence	Post-emergence (3-Leaf stage)
A	80	80	70	30	100	100
	40	50	40	20	100	95
	20	40	30	10	100	90
	10	40	20	5	60	60
B	80	70	60	30	100	100
	40	50	40	20	100	90
	20	40	20	10	100	90
	10	30	20	5	50	50
C	80	70	50	30	100	100
	40	30	30	20	100	100
	20	20	20	10	100	90
	10	10	10	5	40	60
D	80	60	50	30	100	100
	40	30	20	20	100	100
	20	20	10	10	100	90
	10	10	0	5	30	50
E (Pyrazosulfuron-ethyl)	80	30	10	30	30	20
	40	20	0	20	20	0
	20	10	0	10	10	0
	10	0	0	5	0	0

As shown in Table 3a, the standard compound E, at 80 g/ha which is the four-times higher rate than the conventional application rate (20 g/ha), shows little phytotoxicity to rice; 10 or 30% to the transplanted or direct-seeded rice, respectively. Therefore, the compound E is considered to be highly safe to rice. However, it shows weak herbicidal activity to barnyardgrass (10% at 20g/ha), which is the most important weed in rice.

On the contrary, the standard compounds A to D show excellent activity to barnyardgrass, i.e., 95% or greater activity at 20g/ha by pre- or post-emergence treatments. These compounds (A~D) also show rice safety at 20 g/ha; 10 to 40% of phytotoxicity

depending on the compounds. However, for commercial development, a compound should be safe at four-times higher rates than the recommended rate. The compounds A~D show 50~80% of phytotoxicity depending on the compounds at 80g/ha, which is four times as much as the typical dose, and thus, are considered to be impossible to develop commercially.

[Table 3b]

Herbicidal activity and phytotoxicity of the compounds of the present invention in a paddy condition.

Compound	*Oryza sativa*			*Echinochloa crus-galli*		
	Rate (g/ha)	Seed	Trans-planted	Rate (g/ha)	Pre-emergence	Post-emergence (3-Leaf stage)
Com. 1	80	30	20	30	90	100
	40	30	10	20	90	90
	20	10	10	10	80	80
	10	0	0	5	50	60
Com. 2	80	30	10	30	100	100
	40	20	10	20	100	100
	20	0	0	10	100	90
	10	0	0	5	60	50
Com. 3	80	30	20	30	100	100
	40	30	20	20	95	90
	20	10	10	10	90	80
	10	0	5	5	60	60
Com. 4	80	30	20	30	100	100
	40	20	10	20	100	100
	20	0	0	10	95	90
	10	0	0	5	60	60
Com. 5	80	30	20	30	100	100
	40	20	0	20	90	90
	20	10	0	10	80	70
	10	0	0	5	50	60
Com. 6	80	20	20	30	100	100
	40	10	0	20	100	90
	20	0	0	10	80	70
	10	0	0	5	60	50
Com. 7	80	30	20	30	100	100
	40	20	10	20	90	95
	20	0	0	10	80	80
	10	0	0	5	60	50

The compounds of the present invention have excellent herbicidal activity to barnyardgrass as well as improved rice selectivity. As shown in Table 3b, the compounds of the present invention have excellent herbicidal activity against barnyardgrass; 90% or greater depending on the compounds at 20g/ha. Further, they show acceptable rice safety at 80g/ha (30% or less), which is comparable to the standard compound E.

Weed spectrum in paddy field

Pots having a surface area of 500㎠ were filled with the soil in a muddy state as mentioned above. Seeds of annual weeds such as *Monochoria vaginaiis* (MOOVA), *Lindernia procumbens* (LIDPR), *Rotala indica* (ROTIN), *Scirpus juncoides* (SCPJU), etc. were sown on the surface layer of soil, and then were planted tubers of perennial weeds such as *Cyperus serotinus* (CYPSE) and *Sagittaria pygmaea* (SAGPY) in a depth of 1㎝, and *Eleocharis kuroguwai* (ELOKU) and *Sagittaria trifolia* (SAGTR) in a depth of 4㎝. After 5 days, the chemicals were formulated as mentioned above and applied by dropping to the water surface of the pots. The test plants were observed for two weeks after the treatment and the results are given in the following Table 4.

[Table 4]

Weed spectrum of the compounds of the present invention in a paddy condition.

Compound	Rate (g/ha)	Annual weeds				Perennial weeds			
		MOOVA	LIDPR	ROTIN	SCPJU	CYPSE	SAGPY	ELOKU	SAGTR
Com. 2	20	100	100	100	100	100	95	95	90
Com. 4	20	100	100	100	100	100	90	95	85

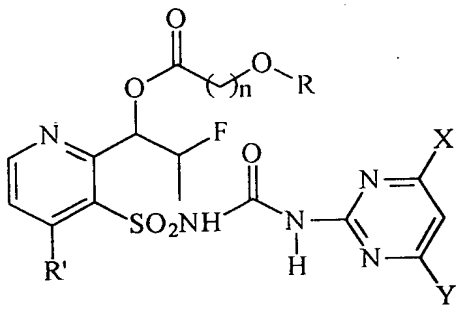
From the results of Table 4, the compounds of the present invention show high activities on various annual and perennial weeds in addition to barnyardgrass.

Consequently, the compounds of the present invention, novel herbicidal molecules in paddy conditions, effectively control the annual and perennial weeds including barnyardgrass by pre- and post-emergence treatment and provide a high level of safety to transplanted and direct-seeded rice. Therefore, they are expected to be used for such

purposes.

Claims:

1. A pyridine sulfonyl urea derivative of the following formula (1):



(1)

in which

n denotes an integer of from 1 to 3,

R represents H or C_1-C_4-alkyl,

R' represents H, C_1-C_4-alkyl, C_1-C_3-haloalkyl, halogen, or C_1-C_2-alkoxy, and

X and Y independently of one another represent C_1-C_2-alkyl, C_1-C_2-alkoxy, C_1-C_2-haloalkoxy, or halogen, salts or stereochemical isomers thereof.

2. The derivative of claim 1 wherein n denotes an integer of 1 or 2, R represents H or methyl, R' represents H, halogen or methyl, and X and Y each represents methoxy.

3. The derivative of claim 1 wherein n denotes an integer of 1 or 2, R represents methyl, R' represents H, Cl, Br or methyl, and X and Y each represents methoxy.

4. The derivative of claim 1 selected from the group consisting of:

N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-2-(2-fluoro-1-methoxy acetoxy-n-propyl)pyridine-3-sulfonamide;

N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-2-(2-fluoro-1-hydroxy acetoxy-n-propyl)pyridine-3-sulfonamide;

N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-2-(2-fluoro-1-(3-hydroxy

propion)oxy-n-propyl)pyridine-3-sulfonamide;

N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-2-(2-fluoro-1-(3-methoxypropion)oxy-n-propyl)pyridine-3-sulfonamide;

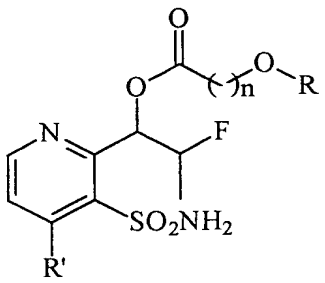
N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-4-methyl-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide;

N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-4-chloro-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide; and

N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-4-bromo-2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide.

5. The derivative of claim 1 which is present in the stereoisomeric form of erythro.

6. A compound of the following formula (6):



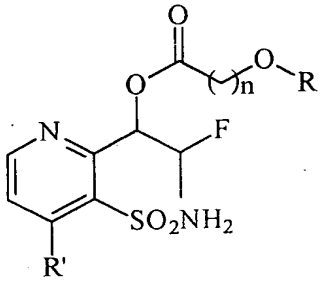
(6)

in which

n, R and R' are defined as in claim 1.

7. The compound of claim 6 which is 2-(2-fluoro-1-methoxyacetoxy-n-propyl)pyridine-3-sulfonamide.

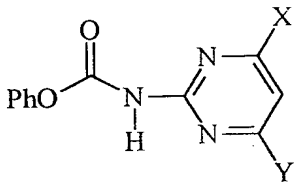
8. A process for preparing the compound of formula (1) as defined in claim 1 characterized in that a compound of the following formula (6):



(6)

in which

n, R and R' are defined as in claim 1, is reacted in a solvent optionally in the presence of a base with a compound of the following formula (7):



(7)

in which

X and Y are defined as in claim 1.

9. The process of claim 8 wherein the base is triethylamine, hexamethylenetetramine, pyridine, 1,8-diazabicyclo[5,4,0]undec-7-ene (DBU) or 1,4-diazabicyclo[2,2,2] octane (DABCO).

10. A herbicidal composition for controlling weeds which comprises as an active ingredient the compound of formula (1) as defined in claim 1 together with carriers.

11. The composition of claim 10 which comprises the compound of formula (1) wherein n denotes an integer of 1 or 2, R represents H or methyl, R' represents H, halogen or methyl, and X and Y each represents methoxy.

12. Method to use of the compound of formula (1) as defined in claim 1 for controlling weeds against rice or wheat in paddy field or upland field condition.

ABSTRACT

The present invention relates to pyridine sulfonyl urea derivatives, salts or stereochemical isomers thereof showing an effective herbicidal activity in pre- and/or post-emergence treatment in rice farming, or to a method to use thereof, a method for the preparation thereof, an intemediate used for the preparation thereof, and a herbicidal composition comprising same.

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August 20, 2001

By Fax-(41-22) 740 14 35

Re: International Application No. PCT/KR00/01138
International Filing Date : October 12, 2000
Priority : None
Applicant : LG CHEMICAL LTD. et al
Agent's File Reference : PC00017-LG

Dear Sirs:

With reference to the above identified international application, LG Chemical Ltd. was the applicant for the purpose of all designated States except the United Staes of America.

We are informing you that the applicant's name was changed from **LG Chemical Ltd.** to **LG Chem Investment Ltd.** on April 3, 2001. The address of the applicant has not been changed.

Changed name : **LG Chem Investment Ltd.**
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Nationality : Republic of Korea

We request that the International Bureau of WIPO record the changed name of the applicant and notify all Offices and PCT Authorities concerned of the change of name accordingly. We would appreciate receiving a Notification of the Recording of a Change (Form PCT/IB/306) as quickly as possible. The original of this letter will be sent to you by DHL courier.

Respectfully submitted

Kyu Pal CHOI, Patent Attorney

KPC/BKS

PC00017-LG

PCT REQUEST

Original (for **SUBMISSION**) - printed on 12.10.2000 10:59:31 AM

0	**For receiving Office use only**	
0-1	International Application No.	
0-2	International Filing Date	
0-3	Name of receiving Office and "PCT International Application"	
0-4	**Form - PCT/RO/101 PCT Request**	
0-4-1	Prepared using	PCT-EASY Version 2.91 (updated 01.07.2000)
0-5	**Petition** The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	**Receiving Office (specified by the applicant)**	Korean Industrial Property Office (RO/KR)
0-7	**Applicant's or agent's file reference**	PC00017-LG
I	**Title of invention**	HERBICIDALLY ACTIVE PYRIDINE SULFONYL UREA DERIVATIVES
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III-7-6	State of nationality	KR
III-7-7	State of residence	KR
III-8	**Applicant and/or inventor**	
III-8-1	This person is:	applicant and inventor
III-8-2	Applicant for	US only
III-8-4	Name (LAST, First)	KO, Young-Kwan
III-8-5	Address:	Hanbit Apt. #102-1702, Uh-eun-dong, Yusong-gu, 305-755 Taejon Republic of Korea
III-8-6	State of nationality	KR
III-8-7	State of residence	KR
III-9	**Applicant and/or inventor**	
III-9-1	This person is:	applicant and inventor
III-9-2	Applicant for	US only
III-9-4	Name (LAST, First)	RYU, Jae-Wook
III-9-5	Address:	Hanbit Apt. #120-305, Uh-eun-dong, Yusong-gu, 305-755 Taejon Republic of Korea
III-9-6	State of nationality	KR
III-9-7	State of residence	KR

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IV-1	**Agent or common representative; or address for correspondence** The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:	agent
IV-1-1	Name (LAST, First)	CHOI, Kyu-Pal
IV-1-2	Address:	824-11, Yeoksam-dong, Kangnam-ku, 135-080 Seoul Republic of Korea
IV-1-3	Telephone No.	(82-2) 555-6888
IV-1-4	Facsimile No.	(82-2) 555-9888
IV-1-5	e-mail	HANSUNGP@chollian.net
V	**Designation of States**	
V-1	Regional Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	AP: GH GM KE LS MW MZ SD SL SZ TZ UG ZW and any other State which is a Contracting State of the Harare Protocol and of the PCT EA: AM AZ BY KG KZ MD RU TJ TM and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT EP: AT BE CH&LI CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE and any other State which is a Contracting State of the European Patent Convention and of the PCT OA: BF BJ CF CG CI CM GA GN GW ML MR NE SN TD TG and any other State which is a member State of OAPI and a Contracting State of the PCT
V-2	National Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH&LI CN CR CU CZ DE DK DM DZ EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ PL PT RO RU SD SE SG SI SK SL TJ TM TR TT TZ UA UG US UZ VN YU ZA ZW

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V-5	**Precautionary Designation Statement** In addition to the designations made under items V-1, V-2 and V-3, the applicant also makes under Rule 4.9(b) all designations which would be permitted under the PCT except any designation(s) of the State(s) indicated under item V-6 below. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit.		
V-6	**Exclusion(s) from precautionary designations**	NONE	
VI	**Priority claim**	NONE	
VII-1	**International Searching Authority Chosen**	Korean Industrial Property Office (KIPO) (ISA/KR)	
VIII	**Check list**	number of sheets	electronic file(s) attached
VIII-1	Request	6	-
VIII-2	Description	35	-
VIII-3	Claims	5	-
VIII-4	Abstract	1	pc00017.txt
VIII-5	Drawings	0	-
VIII-7	TOTAL	47	
	Accompanying items	paper document(s) attached	electronic file(s) attached
VIII-8	Fee calculation sheet	✓	-
VIII-9	Separate signed power of attorney	✓	-
VIII-16	PCT-EASY diskette	-	diskette
VIII-18	**Figure of the drawings which should accompany the abstract**		
VIII-19	**Language of filing of the international application**	Korean	
IX-1	**Signature of applicant or agent**		
IX-1-1	Name (LAST, First)	CHOI, Kyu-Pal	

FOR RECEIVING OFFICE USE ONLY

10-1	**Date of actual receipt of the purported international application**	
10-2	**Drawings:**	
10-2-1	Received	
10-2-2	Not received	
10-3	**Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application**	

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10-4	Date of timely receipt of the required corrections under PCT Article 11(2)	
10-5	International Searching Authority	ISA/KR
10-6	Transmittal of search copy delayed until search fee is paid	

FOR INTERNATIONAL BUREAU USE ONLY

11-1	Date of receipt of the record copy by the International Bureau	

PCT (ANNEX - FEE CALCULATION SHEET)

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(This sheet is not part of and does not count as a sheet of the international application)

0 0-1	**For receiving Office use only** International Application No.	
0-2	Date stamp of the receiving Office	

0-4	**Form - PCT/RO/101 (Annex)** **PCT Fee Calculation Sheet**				
0-4-1	Prepared using		PCT-EASY Version 2.91 (updated 01.07.2000)		
0-9	**Applicant's or agent's file reference**		PC00017-LG		
2	**Applicant**		LG CHEMICAL LTD. , et al.		
12	**Calculation of prescribed fees**		fee amount/multiplier	total amounts (KRW)	
12-1	Transmittal fee	T	⇨	45,000	
12-2	Search fee	S	⇨	150,000	
12-3	International fee Basic fee (first 30 sheets)	b1	464,100		
12-4	Remaining sheets		17		
12-5	Additional amount	(X)	10,700		
12-6	Total additional amount	b2	181,900		
12-7	b1 + b2 =	B	646,000		
12-8	Designation fees Number of designations contained in international application		86		
12-9	Number of designation fees payable (maximum 8)		8		
12-10	Amount of designation fee	(X)	100,000		
12-11	Total designation fees	D	800,000		
12-12	PCT-EASY fee reduction	R	-142,800		
12-13	Total International fee (B+D-R)	I	⇨	1,303,200	
12-17	**TOTAL FEES PAYABLE (T+S+I+P)**		⇨	1,498,200	
12-19	**Mode of payment**		cash		

VALIDATION LOG AND REMARKS

13-2-1	**Validation messages** **Request**	Green? A translation of the international application into English will have to be prepared under the responsibility of the ISA selected.
		Green? Please note that the entire request (including the title of invention) must be in English

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13-2-2	Validation messages States	Green? More designations could be made. The following States have not been designated: KR. Please verify.
13-2-4	Validation messages Priority	Green? No priority of an earlier application has been claimed. Please verify
13-2-6	Validation messages Contents	Green? The international application contains no drawings. Please verify.
13-2-10	Validation messages For receiving Office/International Bureau use only	Green? Verify electronic data for consistency against printed form.